



RICO SITE REMEDIATION PROJECT

SURFACE WATER MONITORING PROGRAM

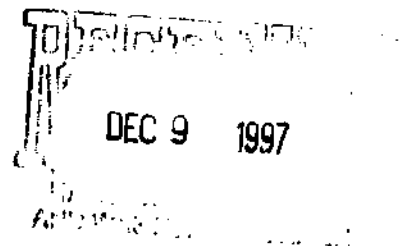
POST-VCUP INTERIM REPORT

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**RICO SITE REMEDIATION PROJECT
SURFACE WATER MONITORING PROGRAM
POST-VCUP INTERIM REPORT**

EXECUTIVE SUMMARY

Remediation of seven inactive mine and mill tailings sites in Rico, Colorado ("Site") was completed by ARCO in October 1996 under the Colorado Voluntary Cleanup and Redevelopment Act in cooperation with the current land owners. Remedial measures were implemented in accordance with five Voluntary Cleanup Plans (VCUPs) submitted to and approved by the Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division for the following sites:

- Argentine tailings
- Columbia and old Pro Patria mill tailings and Silver Swan east wasterock pile
- Grand View smelter
- Santa Cruz mine area
- Silver Swan mine area

Surface-water quality has been monitored in the Silver Creek and Dolores River drainages at the Site since June 1995 in accordance with the monitoring program set forth in each VCUP. Quarterly sampling was conducted between June 1995 and April 1996 to establish baseline or pre-VCUP implementation surface water quality conditions. Subsequent to completion of Site remedial construction in October 1996, a two-year post-VCUP implementation monitoring program was initiated for assessment of the impact of Site remediation on surface-water quality. The first year of the post-VCUP monitoring program was completed in July 1997. This report presents both the results and a comparative evaluation of pre-VCUP and post-VCUP water quality results compiled to date.

The first year of post-VCUP monitoring included quarterly sampling at 15 locations in October 1996, January, April and July 1997. Sampling locations were consistent with pre-VCUP sampling and provided selected water quality and quantity data relative to four VCUP sites: Argentine tailings in the Silver Creek drainage; and Columbia tailings, Santa Cruz mine, and Silver Swan mine in the Dolores River drainage.

Sampling and analysis of surface water followed standard procedures for all pre- and post-VCUP monitoring. Sample collection was performed by ESA Consultants Inc., including measurement of water temperature, pH, conductivity, alkalinity, and iron II/total iron at the time of sample collection. Samples were sent to Columbia Analytical Services in Kelso, Washington for determination of selected dissolved metals, total dissolved solids, total suspended solids, hardness, sulfate, cyanide, and tetrachloroethene (PCE) concentrations. PTI Environmental Services in Lake Oswego, Oregon performed a quality assurance review of all laboratory analyses in accordance with

EPA Contract Laboratory Program guidelines. All of the analytical results are acceptable and considered useable for data interpretation.

The construction of Site remediation systems and assessment of pre-construction and post-construction water quality conditions support the following conclusions:

- Constructed drainage diversions, infiltration barriers and erosion controls have effectively reduced or eliminated surface water contact with mineralized mine waste and tailings.
- There was no significant change in the average quality and quantity of flow from the Argentine seep or the Rico Boy, Santa Cruz, and Silver Swan mine adits during the first year after completion of Site remediation.
- Water in Silver Creek and the Dolores River and surface water draining from the Argentine, Santa Cruz, and Silver Swan sites continue to consistently exhibit neutral pH and naturally moderate to high alkalinity (neutralizes acid-generating potential of sulfide oxidation).
- Dissolved metals concentrations in Silver Creek and the Dolores River continue to be consistently below applicable water quality standards.
- Dissolved metals loads transported by Silver Creek may have decreased after Argentine site remediation. However, the second year of post-VCUP monitoring is needed to assess whether this apparent decrease is a trend attributable to site remediation or a natural fluctuation in Silver Creek water quality.
- Dissolved metals loads transported by the Dolores River did not change during the first year after Site remediation.

Uncontrolled surface water and adit drainage at the Rico Boy, Santa Cruz, and Silver Swan mine sites historically interacted with mine wastes before draining from such areas. Similar surface-water drainage conditions existed at the Argentine tailings, Columbia tailings, Pro Patria tailings, and Shamrock wasterock sites. Site remediation included construction of a combination of drainage control measures to reduce or eliminate surface-water contact with wastes. Specific control measures included removal of selected waste materials from drainage areas, permanent diversion of surface water away from wastes, constructed barrier systems (e.g., berms, impermeable ditch liners and revegetated caps), and drainage channel stabilization (e.g., riprap erosion protection).

Site remediation has not resulted in a significant change in surface-water quality. Although minor differences in post-VCUP water quality relative to pre-VCUP water quality are indicated by individual monitoring station data, these differences are generally less than the recorded range of historic seasonal and annual fluctuations in water quality.

Water in the Silver Creek and Dolores River drainages and all of the monitored surface-water drainage from the VCUP sites continues to exhibit neutral pH and moderate to high alkalinity. These

characteristics are indicative of the substantial natural buffering capacity of surface water throughout the Rico district due to the abundance of calcium carbonate-bearing rocks (limestone and other limey rock formations). This buffering capacity continues to both neutralize the sulfuric acid-generating potential of sulfide minerals (mainly pyrite) in mined and unmined areas and reduce the load of heavy metals transported in water draining from such areas and in receiving streams.

Although the quality and quantity of monitored seepage flow from the Argentine tailings that enters Silver Creek have not changed significantly, the post-VCUP water quality data indicate a decrease in the load of dissolved metals in Silver Creek relative to the pre-VCUP load. This trend may reflect a decrease in amount of diffused seepage loads from the Argentine tailings to Silver Creek as a result of site remediation. However, based on all available historic water quality data compiled for Silver Creek prior to 1995, the decrease could represent a natural fluctuation in dissolved metals loads. Additional data provided by the final year of VCUP monitoring will be used to further evaluate the dissolved metals loads in Silver Creek downstream from the Argentine tailings relative to the loads immediately upstream from the tailings and those contributed by the Argentine seep.

Post-VCUP monitoring data indicate that dissolved metal loads transported by the Dolores River did not increase due to remediation of the various mine and tailings sites in the river corridor. Sulfate and dissolved metals loads from the Santa Cruz and Silver Swan wetland drainages were too small to impact Dolores River water quality during both pre-VCUP and post-VCUP monitoring.

Loads of dissolved metals from the Columbia tailings to the Dolores River were lower after remediation than pre-VCUP loads. Pre-VCUP seepage from the tailings contributed to increased loads of dissolved iron, manganese, and zinc in the river. Post-VCUP seepage from the tailings did not increase manganese or zinc loads in the river and the iron loading was less than pre-VCUP loadings.

1.0 INTRODUCTION

1.1 Overview of Rico Site Voluntary Remediation Project

Remediation of seven inactive mine and mill tailings sites in Rico, Colorado ("Site") was completed by ARCO in October 1996 under the Colorado Voluntary Cleanup and Redevelopment Act in cooperation with the current land owners (Figure 1-1). The purpose of this voluntary project is to provide long-term protection of human health and the environment based on the intended use of each individual mine or tailings site.

Site remediation was implemented in accordance with five Voluntary Cleanup Plan (VCUP) applications approved by the Colorado Department of Public Health and Environment (CDH), Hazardous Materials and Waste Management Division for the following sites:

- Argentine tailings (ARCO, 1996a)
- Columbia and old Pro Patria mill tailings and Silver Swan east wasterock pile (ARCO, 1996b)
- Grand View smelter (ARCO, 1996c)
- Santa Cruz mine area (ARCO, 1996d)
- Silver Swan mine area (ARCO, 1996e)

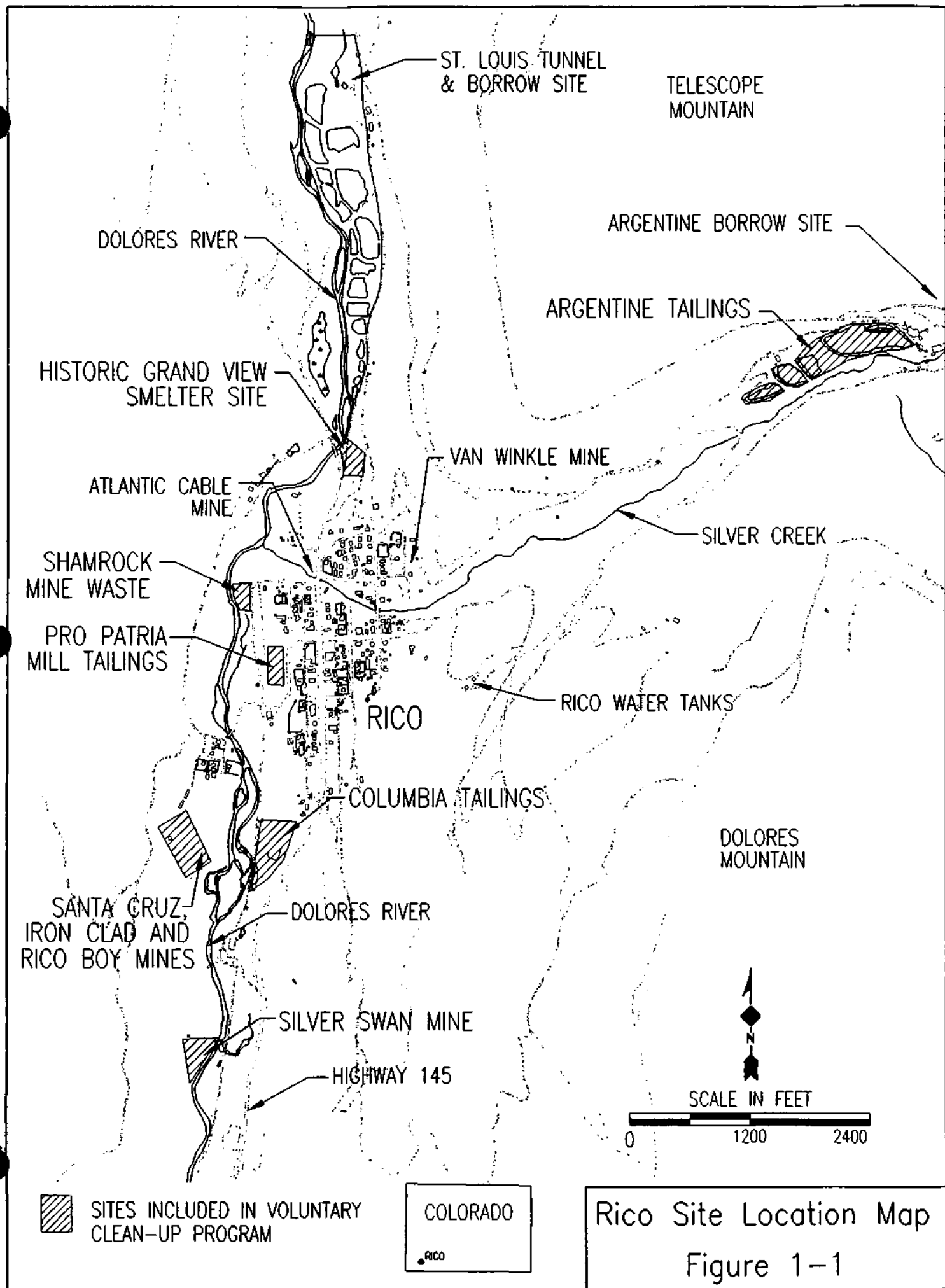
Each of the VCUPs includes a site operations and maintenance plan that describes how the remediation measures are to be maintained and a sampling program that will be used to monitor their effectiveness in achieving the desired goal. This report presents an assessment of remediation system effectiveness based on sampling program results to date.

1.2 Purpose of this Report

This report documents surface-water conditions in the Silver Creek and Dolores River drainages at Rico prior and subsequent to Site remediation. The surface-water monitoring program consists of one year of baseline sampling (pre-VCUP) and two years of confirmatory sampling (post-VCUP). The purpose of this report is to provide sampling results to date and an assessment of remediation effectiveness based on surface-water quality conditions indicated by the first year of post-VCUP sampling relative to identified pre-VCUP water quality conditions.

1.3 Overview of Surface-Water Monitoring Program

Fifteen sampling locations were used to monitor water quality in the Silver Creek and Dolores River drainages upstream and downstream of VCUP sites (Figure 1-1). Silver Creek and seepage to the creek was monitored at four locations in the vicinity of the Argentine tailings site.



The Dolores River and tributary drainage to the river was monitored at eleven locations along a one-mile corridor that encompasses the Columbia, Santa Cruz, and Silver Swan sites.

Pre-VCUP baseline sampling included quarterly events in the summer and fall 1995, and winter and spring 1996. The purpose of this monitoring period was to establish baseline water-quality conditions in the Silver Creek and Dolores River drainages prior to VCUP implementation. Sampling results from this monitoring period are documented in four reports: *Silver Creek and Dolores River Corridor Surface Water Quality Data Report For January and April 1996, Rico, Colorado* (ESA, 1996), *Silver Creek Surface Water Data Report for September 1995, Rico, Colorado* (PTI, 1995a), *Dolores River Corridor Data Report for October, 1995, Rico, Colorado* (PTI, 1995b), and *Summary of Surface Water and Surface Water Groundwater Data for Rico, Colorado* (PTI, 1995c). The latter report also includes historic sampling data for the periods from 1980 to 1984 and 1989 to 1993 that were used to supplement pre-VCUP data and assess post-VCUP water quality conditions.

During the first year of post-VCUP water quality monitoring, confirmatory sampling included quarterly events in October 1996, and January, April, and July 1997. Sampling was performed by ESA Consultants Inc., Fort Collins, Colorado, which included measurement of water temperature, pH, conductivity, alkalinity, and iron II/total iron at the time of sample collection. Samples were analyzed for selected dissolved metals and other indicator parameters by Columbia Analytical Services. PTI Environmental Services performed a quality assurance review of all laboratory analyses.

The following sections present sampling and analysis methods and procedures (Section 2), sampling results and discussion (Section 3), a summary of sampling program conclusions (Section 4), and report references (Section 5). Reference documents provided in the Appendices include photographs (Appendix A), compilation tables for all recorded sampling data by location (Appendix B), field records (Appendix C), laboratory analytical reports (Appendix D), and laboratory analysis quality assurance review reports for the first four quarters of post-VCUP sampling (Appendix E).

2.0 METHODS AND PROCEDURES

2.1 Sampling and Analysis Procedures

Post-VCUP water quality was monitored in the Silver Creek and Dolores River drainages at 15 locations. Both pre- and post-VCUP sampling locations and frequencies are described in Table 2-1. Figures 2-1 and 2-2 show the location of sampling stations. Photographs of sampling locations are provided in Appendix A.

Sampling was implemented in accordance with the sampling program identified in the approved VCUP applications. The procedures used for post-VCUP sampling and analysis followed the *Field Guidance Document, Rico Mine District, Dolores County, Colorado* (PTI, 1995d), and are described in the following paragraphs.

Grab samples of surface water were collected by submerging lab-certified plastic bottles one to four inches below the water surface. Plastic bottles were used to collect samples for total dissolved solids (TDS), total suspended solids (TSS), and sulfate analyses. Samples collected for dissolved metals analyses were filtered directly into plastic bottles that contained nitric acid preservative. Metals samples were filtered within 10 minutes of initial sample collection. Samples for the analysis of cyanide were collected into plastic bottles that contained sodium hydroxide preservative. Samples for the organic analysis of tetrachloroethene (PCE) were collected in amber glass bottles with teflon-lined caps. The amber bottles were filled to ensure that no air bubbles remained in the sample. All sample bottles were packed in ice or snow immediately after filling, and were shipped to the laboratory in coolers with fresh ice.

Field parameters were measured each time a water sample was collected. These measurements are summarized in Appendix B and include flow, pH, specific conductance, temperature, and dissolved oxygen, alkalinity, and iron (II)/ iron (total) concentrations. Field instruments were calibrated each morning with known standard solutions. The dissolved oxygen meter was calibrated at a baseline elevation and correction factors were applied for different sampling station elevations. Field measurements were recorded in a logbook, and on a sampling form and discharge data sheet. Copies of all field records are provided in Appendix C. All field logbooks and other field records are maintained at ESA's office in Fort Collins, Colorado.

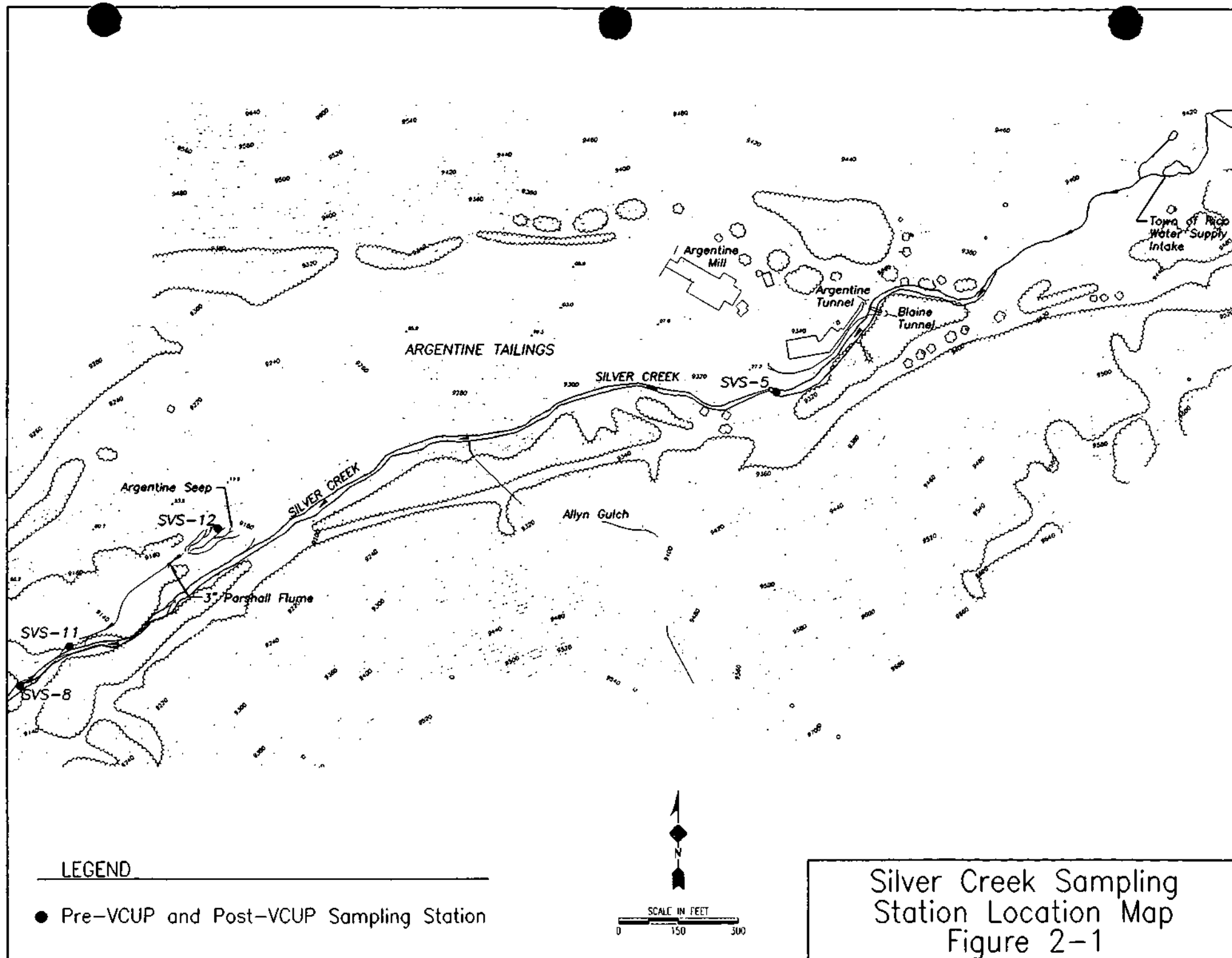
All water samples were sent to Columbia Analytical Services in Kelso, Washington. Laboratory analytes, methods, and reporting limits are presented in Table 2-2. Analytical reports are provided in Appendix D. Cyanide, mercury, and PCE were added as site-specific analytes at the request of CDH. Cyanide was included in the analyses two times for the Argentine seep (fall 1996/summer 1997) and one time for the Dolores River at the Columbia tailings site (fall 1996). PCE was included for flow from the Argentine seep one time (fall 1996). Dissolved mercury was included for the Santa Cruz adit flow one time (fall 1996).

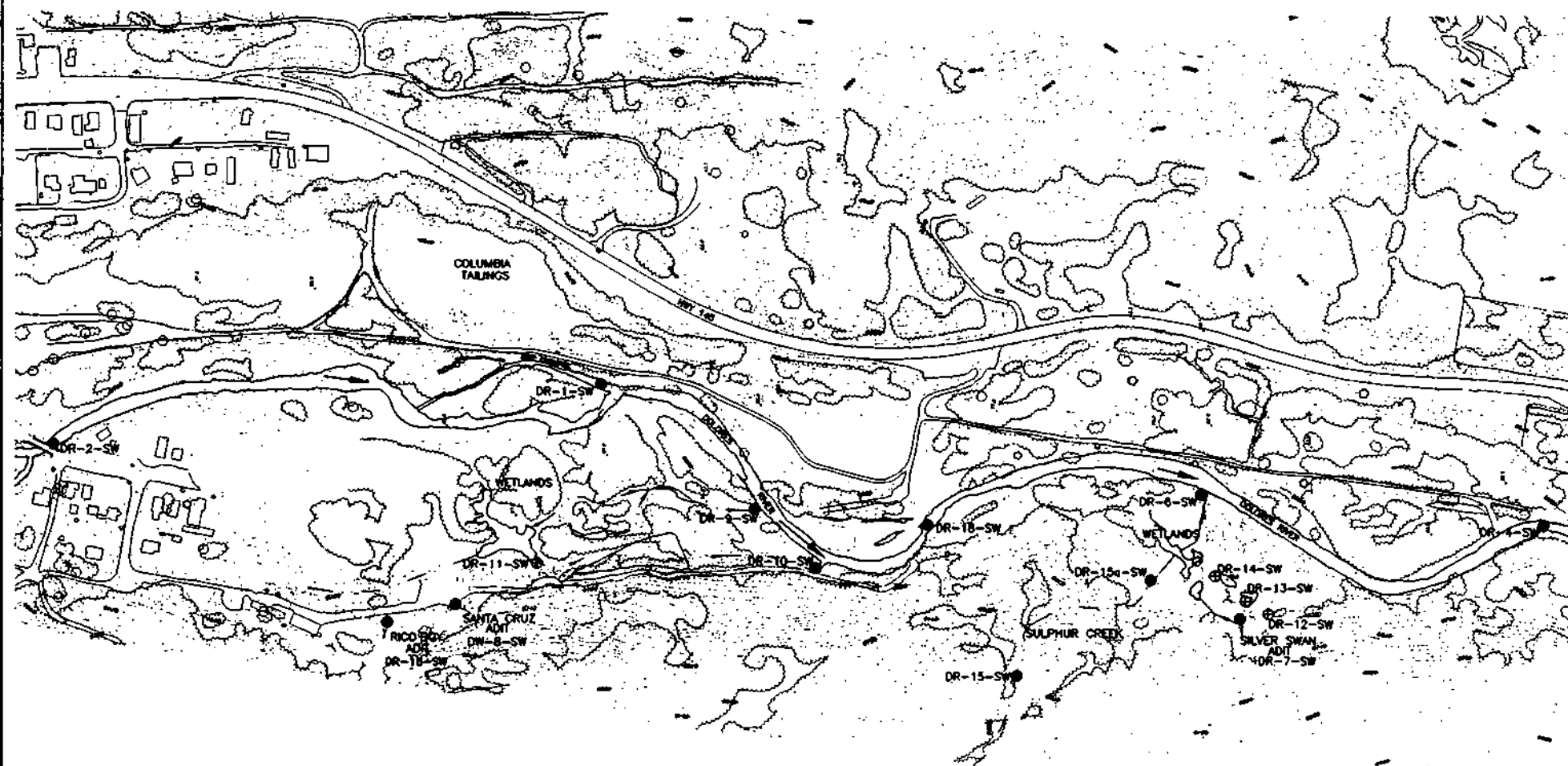
TABLE 2-1

Sampling Location Descriptions and Sampling Event Summary

Station I.D.	Location Description	Pre-VCUP Sampling				Post-VCUP Sampling			
		June 95	Sep/Oct 95	Jan 96	Apr 96	Oct 96	Jan 97	Apr 97	June 97
SVS-5	Silver Creek upstream of Argentine tailings	1	X	2	X	X	2	X	X
SVS-8	Silver Creek downstream of Argentine tailings	1	X	X	X	X	X	X	X
SVS-11	Argentine seep flow above confluence with Silver Creek	1	X	X	X	X	X	X	X
SVS-12	Argentine tailings seep at source	X	X	X	X	X	X	X	X
DR-2-SW	Dolores River upstream of Santa Cruz site	1	X	X	X	X	X	X	X
DR-4-SW	Dolores River downstream of Silver Swan site	1	X	X	X	X	X	X	X
DR-6-SW	Silver Swan wetland drainage	1	X	2	X	X	2	X	X
DR-7-SW	Silver Swan adit	X	X	X	X	X	X	X	X
DR-8-SW	Santa Cruz adit	X	X	X	X	X	X	X	X
DR-9-SW	Santa Cruz wetland east drainage	X	X	X	X	X	X	X	4
DR-10-SW	Santa Cruz wetland west drainage	1	X	2	X	3	2	X	X
DR-11-SW	Santa Cruz wetland near wasterock pile	1	X	X	X	5	5	5	5
DR-12-SW	Silver Swan discharge at south branch	1	X	2	3	5	5	5	5
DR-13-SW	Silver Swan wetland 60 ft from Silver Swan adit	1	X	X	X	5	5	5	5
DR-14-SW	Silver Swan wetland above Sulphur Creek confluence	1	X	X	X	5	5	5	5
DR-15a-SW	Sulphur Creek above Silver Swan wetland confluence	1	X	X	X	3	2	X	X
DR-16-SW	Rico Boy adit	1	X	X	X	X	X	X	X
DR-18-SW	Dolores River below Columbia tailings	1	1	X	X	X	X	X	X

- X Samples collected
 1 Not a designated sampling location at time of sampling event
 2 Zero flow (frozen)
 3 Zero flow (dry)
 4 Not sampled due to overflow and mixing from the Dolores River
 5 Sampling location eliminated after VCUP implementation (drainage permanently diverted away from wasterock)





LEGEND

- Pre-VCUP and Post-VCUP Sampling Station
- ⊕ Pre-VCUP Sampling Station used to sample drainage in direct contact with wasterock; condition eliminated by VCUP implementation.



SCALE IN FEET
0 200 400

Dolores River Corridor
Sampling Station Location Map
Figure 2-2

TABLE 2-2

Laboratory Analysis Summary with Methods and Reporting Limits

ANALYTE (unit)	METHOD REPORTING LIMIT	METHOD
Cadmium ($\mu\text{g/L}$ as Cd)	0.02 $\mu\text{g/L}$	EPA 200.8 ICP/MS
Copper ($\mu\text{g/L}$ as Cu)	10 $\mu\text{g/L}$	EPA 6010 ICP/AES
Cyanide (mg/L as CN)	0.01 mg/L	EPA 9012A
Hardness (mg/L as CaCO_3)	0.2 mg/L	Standard Method 2340B
Iron ($\mu\text{g/L}$ as Fe)	20 $\mu\text{g/L}$	EPA 6010 ICP/AES
Lead ($\mu\text{g/L}$ as Pb)	0.5 $\mu\text{g/L}$	EPA 200.8 ICP/MS
Manganese ($\mu\text{g/L}$ as Mn)	5 $\mu\text{g/L}$	EPA 6010 ICP/AES
Mercury ($\mu\text{g/L}$ as Hg)	0.05 $\mu\text{g/L}$	EPA 7470 ICP/MS
Silver ($\mu\text{g/L}$ as Ag)	0.02 $\mu\text{g/L}$	EPA 200.8 ICP/MS
Sulfate (mg/L as SO_4)	0.2 mg/L	EPA 300.0
Tetrachloroethene ($\mu\text{g/L}$)	0.05 $\mu\text{g/L}$	EPA 8260
Total Dissolved Solids (mg/L as TDS)	5 mg/L	EPA 160.1
Total Suspended Solids (mg/L as TSS)	5 mg/L	EPA 160.2
Zinc ($\mu\text{g/L}$ as Zn)	10 $\mu\text{g/L}$	EPA 6010 ICP/AES
ICP/AES = Inductively coupled plasma/atomic emission spectrometry		
ICP/MS = Inductively coupled plasma/mass spectrometry		

2.2 Discharge-Measurement Procedures

Discharge was measured at all sampling stations with measurable flow. Flow was often determined by using a Marsh McBirney RMB 2000 flow meter or by recording the time necessary for the discharge to fill a 5-gallon bucket (volumetric measurement). If the maximum depth of water in the channel was less than 0.3 feet, surface velocity was calculated by measuring the time it took for a piece of floating debris to travel a measured distance. The resulting velocity was then multiplied by the channel cross-section to estimate discharge. Flow from the Argentine tailings seep was measured using a stationary 3-inch Parshall flume. Discharge measurement field sheets, calculations and the reference table for the flume are provided in Appendix C. During the winter

months, Dolores River flow could not be effectively measured due to ice cover and Silver Creek at the upstream station (SVS-5) was frozen over. Dolores River flow was not measured during the Summer 1997 sampling event because the river could not be safely waded.

2.3 Quality Assurance Review

Data reported by the laboratory are acceptable and usable for data interpretation. Abbreviated Level 3 quality assurance reviews of laboratory data were completed by PTI Environmental Services, Lake Oswego, Oregon. Data quality was assessed in terms of general method-specific quality control limits and guidance specified by U.S. Environmental Protection Agency (EPA) *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (U.S. EPA, 1994a) and *Contract Laboratory Program National Functional Guidelines for Organic Data Review* U.S. EPA, 1994b). Quarterly data validation summary reports and a quality assurance review summary report for all laboratory data were prepared by PTI. These reports and the laboratory QA/QC reports are provided in Appendix E.

3.0 RESULTS AND DISCUSSION

This section provides results and discussion of pre-VCUP and post-VCUP surface water monitoring. Post-VCUP results were compared to pre-VCUP monitoring results to evaluate impacts of remediation activities on water quality at the specific sites and in Silver Creek and the Dolores River. Historic data was used in the evaluations when pre-VCUP data was not representative of baseline conditions.

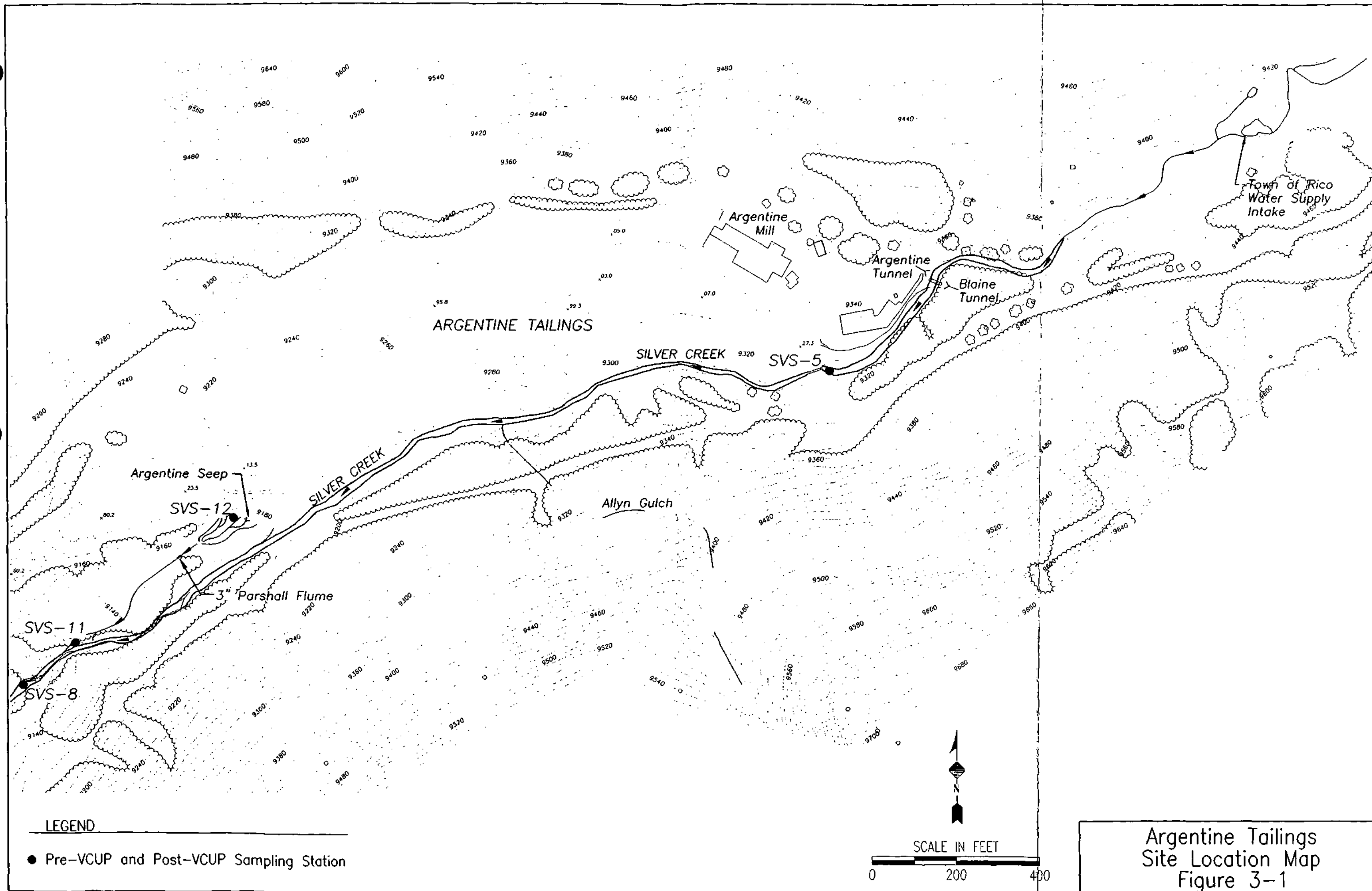
3.1 Silver Creek Corridor Monitoring Results

Silver Creek was monitored above (SVS-5) and below (SVS-8) the Argentine tailings site during pre-VCUP and post-VCUP water quality sampling. Potential surface drainage to Silver Creek in the vicinity of these two sampling locations included the Blaine Tunnel, Allyn Gulch, and seepage from the Argentine tailings. Periodic drainage from the Blaine Tunnel and Allyn Gulch were not monitored. Seepage originating from several small seeps at the toe of Argentine tailings was monitored at two locations during pre-VCUP and post-VCUP sampling. During the monitoring periods, flow from the different seeps combined near the toe of the tailings, and drained through wetland areas parallel to Silver Creek for approximately 500 feet before entering Silver Creek. The seepage was monitored at its origin (SVS-12) and immediately above its confluence with Silver Creek (SVS-11). Flow measurements for the seepage were measured at a flume approximately 200 feet downstream from the seep. Figure 3-1 illustrates the described flows and approximate location of these monitoring locations.

3.1.1 Argentine Tailings Seep

Average flows and parameter concentrations for the seepage are presented in Table 3-1. Although there were differences in pre-VCUP and post-VCUP average values, the range of values measured during both monitoring periods were similar. This was true at both monitoring locations. Concentration trends from the seep to the confluence with Silver Creek were also similar during pre-VCUP and post-VCUP monitoring. During both monitoring periods, the average concentrations of analyzed dissolved metals decreased from the seep to the Silver Creek confluence (Table 3-1) while values of pH increased. Dissolved cadmium was the only exception; concentrations increased during post-VCUP sampling (Table 3-1). During post-VCUP monitoring, the pH ranged from 6.5 to 7.6 at the seep while near the confluence with Silver Creek it ranged from 7.3 to 8.3. Concentrations of dissolved copper and silver were relatively low or not detected in both locations during both pre-VCUP and post-VCUP monitoring.

Low concentrations of cyanide were measured in seepage near its origin during pre-VCUP monitoring (Table 3-1). Concentrations of cyanide were below the method detection limit (0.01 mg/L) during post-VCUP sampling. Tetrachloroethene (PCE) was not detected in seepage near its origin during either pre-VCUP or post-VCUP monitoring.



LEGEND

- Pre-VCUP and Post-VCUP Sampling Station

SCALE IN FEET

0 200 400

Argentine Tailings
Site Location Map
Figure 3-1

TABLE 3-1

Argentine Tailings Seepage Water Quality¹

Parameter ²	Seepage Origin (SVS-12)		Above Silver Confluence (SVS-11)	
	Pre-VCUP Average	Post-VCUP Average	Pre-VCUP Average	Post-VCUP Average
Flow (gpm)	45 ³	46 ³	- - -	- - -
TDS (mg/L)	923	811	944	951
Sulfate (mg/L)	525	423	510	547
Alkalinity (mg/L as CaCO ₃)	141	132	144	112
Hardness (mg/L as CaCO ₃)	660	560	682	658
Cyanide (mg/L as CN)	0.03	<0.01	- - -	- - -
Dissolved Cadmium (µg/L)	1.9	1.6	1.6	2.1
Dissolved Iron (µg/L)	12,900	9,430	6,660	2,410
Dissolved Lead (µg/L)	1.3	1.4	<0.5	<0.5
Dissolved Manganese (µg/L)	7,580	6,080	5,320	5,580
Dissolved Zinc (µg/L)	9,590	5,640	6,580	3,920

Notes:

¹ Includes fall, winter, and spring sampling events. Summer values were not available for both monitoring periods.

² Concentrations of dissolved tetrachloroethene, copper, and silver were relatively low or not detected.

³ Only includes fall and spring sampling events. Summer values were not available for both monitoring periods and pre-VCUP winter flows were influenced by snowmelt.

3.1.2 Silver Creek

Historic flows in Silver Creek ranged from approximately 26 gpm to over 10,000 gpm (ARCO, 1996a). Post-VCUP flows during water quality sampling were similar at the upstream and downstream monitoring stations and consistent with historic and pre-VCUP flows, ranging from 736 gpm to 2,720 gpm. Comparison of pre-VCUP and post-VCUP Silver Creek water quality was accomplished by evaluating concentration trends within the stream segment and parameter loads within Silver Creek.

Concentrations of parameters measured during post-VCUP monitoring of Silver Creek followed trends similar to pre-VCUP monitoring. Average metals concentrations in Silver Creek generally increased from upstream to downstream while pH remained the same or decreased

slightly (Table 3-2). Dissolved cadmium and iron were the only exceptions (Table 3-2). The concentration increases from upstream to downstream were generally less during post-VCUP monitoring (Table 3-2). Concentrations of dissolved copper, lead, and silver were relatively low or not detected in both locations and during both monitoring periods. Values of pH were similar (neutral to alkaline) for both monitoring periods and ranged from 7.2 to 8.0 below the remediation site (SVS-8) during post-VCUP sampling. Alkalinity values were also similar during both monitoring periods, ranging from 86 mg/L as CaCO₃ to 101 mg/L as CaCO₃ below the site (SVS-8) during post-VCUP monitoring.

TABLE 3-2
Silver Creek Water Quality¹

Parameter ²	Upstream (SVS-5)		Downstream (SVS-8)	
	Pre-VCUP Average	Post-VCUP Average	Pre-VCUP Average	Post-VCUP Average
Flow (gpm)	945	1,440	969	1,030
TDS (mg/L)	142	137	257	213
Sulfate (mg/L)	19	18	98 ³	68
Alkalinity (mg/L as CaCO ₃)	94	103	105	94
Hardness (mg/L as CaCO ₃)	117	103	198	163
Dissolved Cadmium (µg/L)	2.8	2.6	2.5	2.2
Dissolved Iron (µg/L)	69	175	369	91
Dissolved Manganese (µg/L)	60	121	497	398
Dissolved Zinc (µg/L)	473	463	1,100	686

Notes:

- ¹ Includes fall and spring sampling events. Winter and summer values were not available for both monitoring periods.
- ² Concentrations of dissolved copper, lead, and silver were relatively low or not detected.
- ³ Only fall sampling event value was used. Sulfate concentration for spring sampling event was inconsistent with TDS value and historic data and therefore was not used in average calculations.

Although Silver Creek flows were not the same during the pre-VCUP and post-VCUP sampling periods, differences in flows could not completely account for the lower concentration increases measured during post-VCUP monitoring. This was illustrated by comparing upstream and downstream parameter loads during both monitoring periods. By measuring both the concentration of a parameter carried in water and the water flow rate, it is a simple matter to calculate the amount (load) of a parameter transported during a fixed-time interval. This

calculation was performed for Silver Creek upstream (SVS-5) and downstream (SVS-8) of the Argentine remediation site.

Parameter concentrations and flow rates were available for the fall (September 1995 and October 1996) and spring (April 1996 and 1997) sampling events. Calculated sulfate and dissolved iron, manganese, and zinc loads for these periods are presented in Table 3-3. Similar to measured concentrations, calculated loads generally increased from upstream (SVS-5) to downstream (SVS-8). As seen in the Table 3-3, the increase in parameter loads from upstream to downstream was consistently less during post-VCUP monitoring than during pre-VCUP monitoring. The reduction in load increase could have been caused by less parameter loading from the Argentine tailings seepage or other sources between the two monitoring locations. Loading from the seepage could not be evaluated separately from other sources because flow measurements were not available for the seepage near the Silver Creek confluence. However, the reduction in loading, whether from the seepage or other sources, could have been a result of VCUP remediation activities. Observations made during post-VCUP monitoring indicated that the removal of tailings eliminated Argentine ponds as a potential source of contamination that existed during pre-VCUP monitoring. In areas of tailings consolidation, piles were capped, graded, and stabilized to inhibit erosion, infiltration, runoff/runoff, and dispersal of wastes. In addition, all upland drainage has been permanently diverted away from the tailings in a lined ditch.

TABLE 3-3

Silver Creek Loading

Parameter	Fall Monitoring			Spring Monitoring		
	Pre-VCUP lbs/day	Post-VCUP lbs/day	Net Change lbs/day	Pre-VCUP lbs/day	Post-VCUP lbs/day	Net Change lbs/day
Sulfate	625 (796-171) ¹	589 (801-212)	-36	--- ²	679 (880-201)	---
Dissolved Iron	4.0 (5.0-1.0)	0.4 (1.8-1.4)	-3.6	1.4 (1.9-0.5)	0.2 (0.5-0.3)	-1.2
Dissolved Manganese	4.6 (4.8-0.2)	3.7 (4.9-1.2)	-0.9	4.8 (6.1-1.3)	3.9 (4.9-1.0)	-0.9
Dissolved Zinc	5.8 (10.1-4.3)	3.2 (9.2-6.0)	-2.6	7.9 (14.5-6.6)	3.2 (7.7-4.5)	-4.7

Notes:

¹ (Downstream load at SVS-8 minus upstream load at SVS-5)

² Sulfate concentration was inconsistent with TDS value and historic data and therefore was not used in load calculations.

Variations between pre-VCUP monitoring data and historic data from Silver Creek (Table B-1.1 and B-1.2, Appendix B) suggest that differences in measured loads could be a result

of temporal fluctuations in water quality. Additional data from subsequent monitoring will help to evaluate if differences in measured loads were the result of remediation activities. To assist in this evaluation, more emphasis will be placed on measuring seepage flows near the Silver Creek confluence during post-VCUP monitoring.

Measured concentrations of dissolved metals in Silver Creek were compared to applicable water-quality standards. Applicable water-quality standards for Silver Creek in the vicinity of the VCUP remediation site are given in Table 3-4 (CDH, 1995a) and apply to both pre-VCUP and post-VCUP monitoring data. For hardness based standards, average hardness values were calculated from pre-VCUP and post-VCUP data (Anderson, 1997).

TABLE 3-4
Silver Creek Water Quality and Numeric Standards

Parameter ¹	Standard ($\mu\text{g/L}$) ²	85th Percentile Value or (Maximum Concentration)	Equation or Source
Cadmium, acute	17.4	(3.4)	$\text{EXP}\{1.128(\text{Ln}(\text{hardness}) - 2.905)\}$
Cadmium, chronic	5.0	3.4	Fixed in TVS
Copper, acute	28.4	(14.0)	$\text{EXP}\{\text{Ln}(\text{hardness}) \times 0.9422 - 1.4634\}$
Copper, chronic	18.1	5.0	$\text{EXP}\{\text{Ln}(\text{hardness}) \times 0.8545 - 1.465\}$
Iron, chronic	1,000	180	Aquatic Life
Lead, acute	215	(3.9)	$\text{EXP}\{\text{Ln}(\text{hardness} \times 1.6148 - 2.8736)\}$
Lead, chronic	7.91	2.65	$\text{EXP}\{\text{Ln}(\text{hardness}) \times 1.417 - 5.167\}$
Manganese, chronic	1,000	480	Fixed in stream classification table
Silver, acute	4.82	(<0.10)	$\text{EXP}\{\text{Ln}(\text{hardness}) \times 1.72 - 7.21\}$
Silver, chronic	0.76	<0.10	$\text{EXP}\{\text{Ln}(\text{hardness}) \times 1.72 - 9.06\}$
Zinc, chronic	1,100	955	Fixed in stream classification table

Notes:

¹ Values are in $\mu\text{g/L}$ and for the dissolved fraction.

² A hardness value of 165 mg/L as CaCO_3 was used for hardness based standards. The value equals the calculated mean of pre-VCUP and post-VCUP monitoring in Silver Creek.

Samples composited over a thirty-day period are appropriate for comparison against chronic standards, while grab samples are appropriate for comparison against acute standards. All sampling events on Silver Creek were based on grab samples. However, in the absence of composite sample data, it has been recommended that the 85th percentile of grab sample results be used for comparison with chronic standards (Anderson, 1997). When grab sample results are ranked in order of increasing concentrations, the 85th percentile value is the concentration associated with the sample that has 85% of the other samples ranked below. If the 85th percentile value is less than the chronic standard, water quality standards have not been exceeded. In Table 3-4, the 85th percentile value is presented for chronic standards and the maximum parameter concentration measured during VCUP monitoring is presented for acute standards.

Only pre-VCUP and post-VCUP monitoring data were compared to acute standards. When comparing monitoring data to chronic standards, all historic, pre-VCUP, and post-VCUP data were used to calculate the 85th percentile (Anderson, 1997). All pre-VCUP and post-VCUP parameter concentrations measured in Silver Creek were below applicable standards.

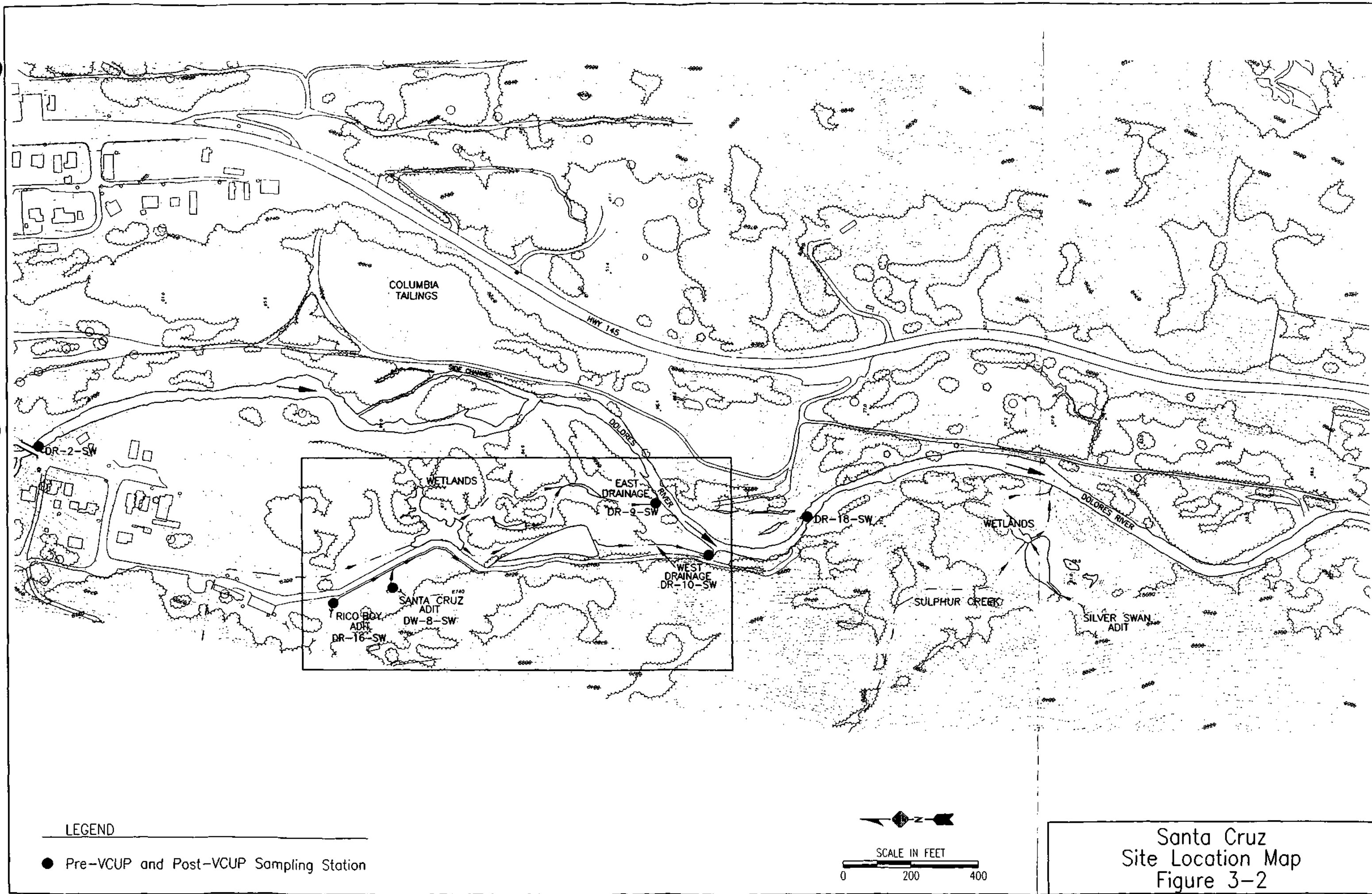
3.2 Dolores River Corridor Monitoring Results

Pre-VCUP and post-VCUP water quality sampling was performed at Dolores River monitoring locations and the Santa Cruz, Columbia tailings, and Silver Swan VCUP remediation sites. Data collected during the monitoring periods were used to evaluate site water-quality conditions and any drainage impacts on the Dolores River.

3.2.1 Santa Cruz Remediation Site

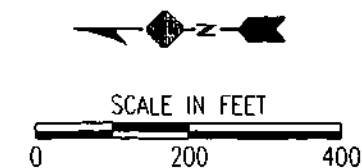
Santa Cruz monitoring locations are illustrated on Figure 3-2. Pre-VCUP and post-VCUP water quality data for the Santa Cruz remediation site were available from monitoring stations located at the Rico Boy adit (DR-16-SW) and the Santa Cruz adit (DR-8-SW). Flows from these adits had historically crossed exposed wasterock material prior to draining into the Santa Cruz wetland area and eventually the Dolores River. The wetland area drained into the river from two distinct points; the west drainage (DR-10-SW), and the east drainage (DR-9-SW). The west drainage area typically received its flow from the adits while the east drainage received overland flows from other areas of the wetland that also contained exposed wasterock. During VCUP activities, mine wastes at the Santa Cruz site were consolidated outside of the wetland areas, graded, stabilized, and capped. Flows from the adits were directed away from mine wasterock, through a constructed pond, and back to the west wetland drainage.

Average values from pre-VCUP and post-VCUP monitoring of the Rico Boy and Santa Cruz adits are presented in Table 3-5. Differences between pre-VCUP and post-VCUP average concentrations were relatively small for both adits, and variations in concentrations during individual sampling events were within the historic range of measured concentration fluctuations (Tables B-1.10 and B-1.14, Appendix B). Values of pH ranged from 6.3 to 8.3 for the Rico Boy adit and 6.0 to 7.7 for the Santa Cruz adit during the two monitoring periods. Compared to each other, the Rico Boy and Santa Cruz adit drainages differed in both flow and water quality during both monitoring periods. Average flows from the Rico Boy adit were less than those from the



LEGEND

● Pre-VCUP and Post-VCUP Sampling Station



Santa Cruz
Site Location Map
Figure 3-2

Santa Cruz adit (Table 3-5). Average concentrations of TDS, sulfate, alkalinity, and hardness were similar for both adits, but average concentrations of dissolved metals were typically higher from the Rico Boy adit than from the Santa Cruz adit. The only exception was the average concentration of dissolved copper. Dissolved copper was not detected in flow from the Rico Boy adit. Concentrations of dissolved silver were relatively low or not detected in flows from both adits.

TABLE 3-5

Rico Boy and Santa Cruz Adit Water Quality¹

Parameter ²	Rico Boy Adit (DR-16-SW)		Santa Cruz Adit (DR-8-SW)	
	Pre-VCUP Average	Post-VCUP Average	Pre-VCUP Average	Post-VCUP Average
Flow (gpm)	1.9	4.6	24	20
TDS (mg/L)	1,170	1,090	1,050	1,130
Sulfate (mg/L)	340	300	270	277
Alkalinity (mg/L as CaCO ₃)	658	629	637	695
Hardness (mg/L as CaCO ₃)	989	1,020	931	960
Dissolved Cadmium (µg/L)	21	15	2.4	2.0
Dissolved Copper (µg/L)	< 10	< 10	17	14
Dissolved Iron (µg/L)	55	62	69	57
Dissolved Lead (µg/L)	< 0.5	0.75	< 0.5	< 0.5
Dissolved Manganese (µg/L)	964	1,230	210	260
Dissolved Zinc (µg/L)	9,220	8,280	1,240	1,220

Notes:

- ¹ Includes fall, winter, and spring sampling events. Summer values were not available for both monitoring periods.
- ² Concentrations of dissolved silver in samples from both adits were relatively low or undetected.

To evaluate the effects of remediation on the west wetland drainage, the water quality of the drainage during each monitoring period was compared to the water quality of the combined adit flow. The west wetland drainage was only flowing during the fall and spring pre-VCUP sampling events, and during the spring and summer post-VCUP sampling events. In order to compare water quality during similar seasons, the spring sampling data were compared. The combined adit flow and west wetland drainage water quality data presented in Table 3-6 indicate that the wetland buffering capacity remained higher and the dissolved metals removal was greater during the post-VCUP sampling event. Values of pH in the wetland drainage were 7.3 during

post-VCUP sampling, and 5.8 during pre-VCUP sampling. Alkalinity decreased through the wetland during pre-VCUP sampling, but remained relatively the same during post-VCUP sampling (Table 3-6). As seen in Table 3-6, dissolved zinc concentrations decreased through the wetland during pre-VCUP and post-VCUP sampling. Concentrations of dissolved cadmium, copper, and manganese also decreased through the wetland during post-VCUP sampling. Decreases in metals concentrations through the wetland could have been caused by an increase in removal through the wetland and constructed pond or the elimination of contaminant sources (e.g., exposed mine waste).

TABLE 3-6

Combined Adit Flow and Wetland Drainage Water Quality

Parameter ¹	Combined Adit Flow ² (DR-16-SW+DR-8-SW)		West Wetland Drainage (DR-10-SW)	
	April 1996	April 1997	April 1996	April 1997
TDS (mg/L)	1,080	1,050	726	1,080
Sulfate (mg/L)	275	281	290	320
Alkalinity (mg/L as CaCO ₃)	635	595	260	530
Hardness (mg/L as CaCO ₃)	935	911	573	903
Dissolved Cadmium (µg/L)	4.1	4.5	4.1	1.5
Dissolved Copper (µg/L)	16	16	56	10
Dissolved Iron (µg/L)	79	45	74	52
Dissolved Manganese (µg/L)	305	547	899	194
Dissolved Zinc (µg/L)	1,920	2,240	1,140	775

Notes:

¹ Concentrations of dissolved lead and silver were relatively low or not detected.

² Concentrations for the combined Rico Boy and Santa Cruz adit flow were calculated using total loads and combined flow.

The east wetland drainage was generally not affected by the adit flows and primarily drained the eastern part of the wetland area. In general, concentrations of most parameters analyzed were lower in the east drainage than in the west drainage. When similar pre-VCUP and post-VCUP quarterly sampling events for the east drainage were compared, concentrations of the parameters analyzed were generally similar (Table B-1.11, Appendix B). Concentrations of dissolved manganese were the exception and increased during post-VCUP monitoring when compared with similar pre-VCUP quarterly sampling events. During post-VCUP monitoring, concentrations of dissolved manganese ranged from 621 µg/L to 1,110 µg/L (168 µg/L to 248

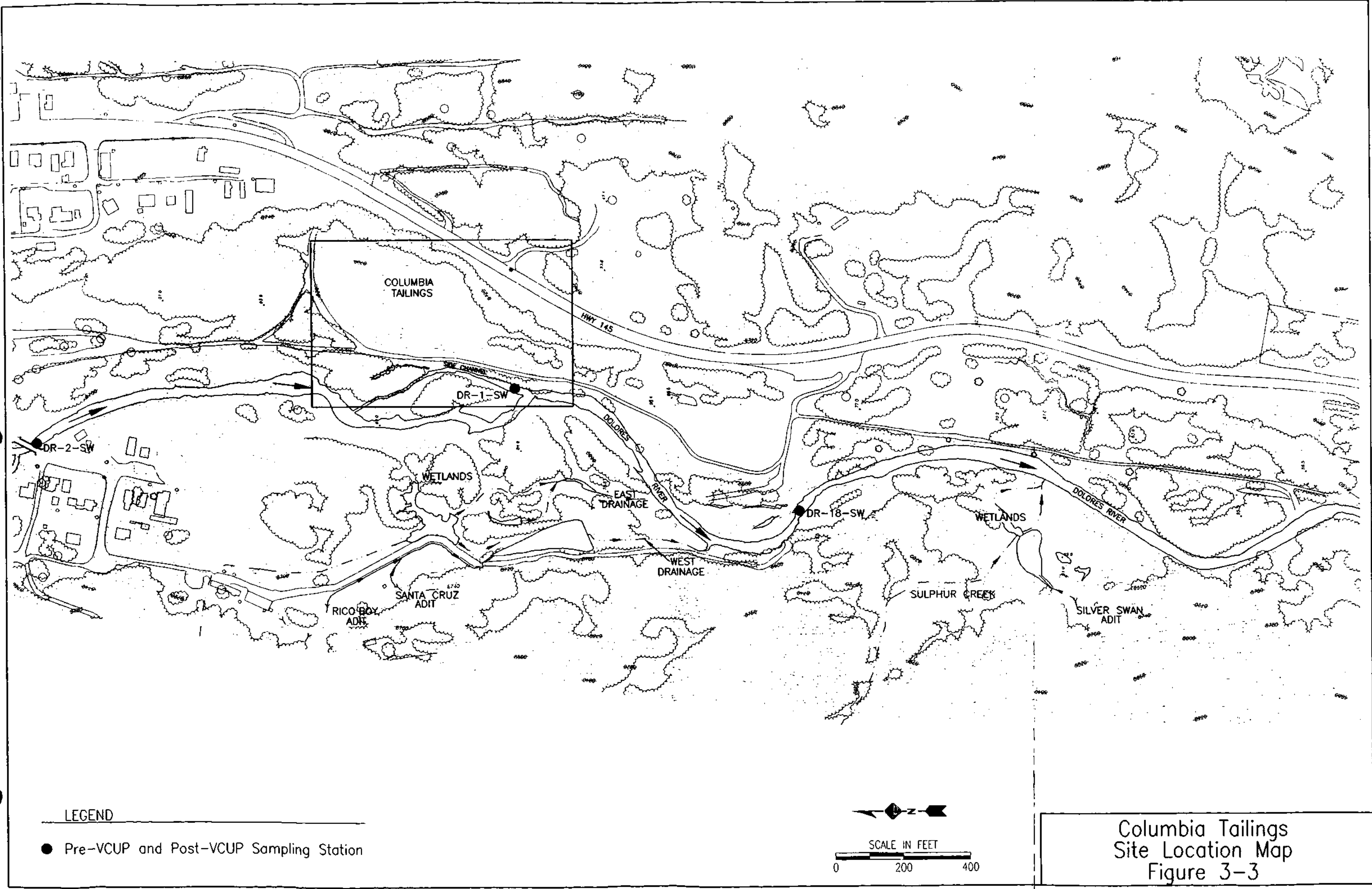
µg/L during pre-VCUP monitoring). Concentrations of dissolved copper, lead, and silver were relatively low or not detected during both monitoring periods. Observations of exposed precipitates in the wetlands east of the service road during post-VCUP monitoring indicated that wetlands disturbed during VCUP remediation may have resulted in the increased manganese concentrations measured at the east drainage. As the wetland area matures and recovers from remediation activities, concentrations of manganese in the wetland drainage should decrease.

3.2.2 Columbia Tailings Remediation Site

Seepage from the Columbia tailings drains into a side channel of the Dolores River (Figure 3-3). Water quality samples were collected in the side channel above its confluence with the main stem of the river (DR-1-SW). During the July 1997 sampling event high flows in the side channel skewed water quality results. The water quality was more characteristic of the mainstem of the river and, therefore, was not representative of baseflow conditions.

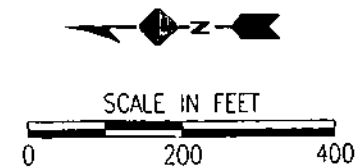
Except as noted above, the average water quality measured in the side channel was similar during both monitoring periods. There were slight differences in the average concentration of some parameters, but the range of values measured during both monitoring periods were similar (Table 3-7). Typical flows measured in the side channel during post-VCUP monitoring ranged from approximately 61 gpm to 238 gpm. Average flows were 157 gpm and similar to pre-VCUP average flows (Table 3-7). Values of pH ranged from 6.0 to 7.2 and were similar during both monitoring periods. Concentrations of dissolved silver were relatively low or not detected.

Pre-VCUP and post-VCUP parameter concentrations did not show consistent trends when individual sampling events were compared. When flow measurements were available (fall and spring sampling events), parameter loads from the side channel were calculated and more consistent trends were observed. Fall parameter loads were greater during post-VCUP monitoring (shortly after VCUP remediation activities were complete). This trend reversed during the spring sampling events; loads measured during pre-VCUP monitoring were greater. Calculated loads for sulfate and dissolved iron, manganese, and zinc during these monitoring periods are presented in Table 3-8.



LEGEND

- Pre-VCUP and Post-VCUP Sampling Station



Columbia Tailings
Site Location Map
Figure 3-3

TABLE 3-7
Dolores River Side Channel Water Quality (DR-1-SW)¹

Parameter ²	Pre-VCUP Average	Post-VCUP Average
Flow (gpm)	148	157
TDS (mg/L)	393	376
Sulfate (mg/L)	237	170
Alkalinity (mg/L as CaCO ₃)	99	133
Hardness (mg/L as CaCO ₃)	290	272
Dissolved Cadmium (µg/L)	8.4	7.0
Dissolved Copper (µg/L)	22	30
Dissolved Iron (µg/L)	7,580	8,360
Dissolved Lead (µg/L)	2.0	1.5
Dissolved Manganese (µg/L)	1,760	2,130
Dissolved Zinc (µg/L)	2,490	2,720

Notes:

¹ Includes fall, winter, and spring sampling events. Summer values were not available for both monitoring periods.

² Concentrations of dissolved silver were relatively low or not detected.

TABLE 3-8
Dolores River Side Channel Parameter Loads (DR-1-SW)

Parameter	Fall Monitoring		Spring Monitoring	
	Pre-VCUP (lbs/day)	Post-VCUP (lbs/day)	Pre-VCUP (lbs/day)	Post-VCUP (lbs/day)
Sulfate	420	610	960	360
Dissolved Iron	11	12	19	9.7
Dissolved Manganese	2.5	3.4	5.1	2.5
Dissolved Zinc	3.3	4.0	7.2	3.3

3.2.3 Silver Swan Remediation Site

Pre-VCUP and post-VCUP water quality data for the Silver Swan remediation site were available from the Silver Swan adit (DR-7-SW). Flows from this adit historically crossed

exposed wasterock prior to draining into the Dolores River. The Silver Swan wetland area received a portion of the adit flow in addition to Sulphur Creek flow (DR-15a-SW). The combined flows eventually entered the Dolores River through the wetland drainage (DR-6-SW). These monitoring locations are illustrated on Figure 3-4. During VCUP activities, mine waste at the Silver Swan site was consolidated away from the Dolores River, graded, stabilized, and capped. Flows from the adit were directed away from wasterock, through a constructed pond, and back into the wetland.

At the Silver Swan adit, average concentrations of measured parameters were generally similar during pre-VCUP and post-VCUP sampling. The concentration of dissolved lead decreased in post-VCUP monitoring samples as compared to pre-VCUP samples, but other average parameter concentrations remained relatively the same (Table 3-9). Concentrations of dissolved copper and silver were either relatively low or not detected during both pre-VCUP and post-VCUP monitoring.

The concentrations of measured parameters in Sulphur Creek were much lower than concentrations measured at all other monitoring stations in the Dolores River corridor (Table 3-9). Concentrations of dissolved copper, iron, manganese, and silver were not detected during monitoring. Sulphur Creek flow combines with and dilutes the Silver Swan adit flow in the wetland prior to entering the Dolores River.

TABLE 3-9
Silver Swan Site Water Quality

Parameter ¹	Silver Swan Adit Drainage ² (DR-7-SW)		Sulphur Creek ³ (DR-15-SW)		Wetland Drainage (DR-6-SW) ⁴	
	Pre-VCUP Average	Post-VCUP Average	Pre-VCUP Average	Post-VCUP Average	Pre-VCUP Average	Post-VCUP Average
TDS (mg/L)	771	832	109	120	222	213
Sulfate (mg/L)	155	163	20	17	48	40
Alkalinity (mg/L as CaCO ₃)	463	493	62	49	145	122
Hardness (mg/L as CaCO ₃)	662	694	84	73	188	171
Dissolved Cadmium (µg/L)	1.0	0.89	0.97	0.55	1.1	0.71
Dissolved Iron (µg/L)	5,620	5,720	<20	<20	43	77
Dissolved Lead (µg/L)	6.7	4.5	1.4	0.84	2.2	0.53
Dissolved Manganese (µg/L)	1,220	1,380	<5.0	<5.0	89	191
Dissolved Zinc (µg/L)	660	702	151	90	256	181

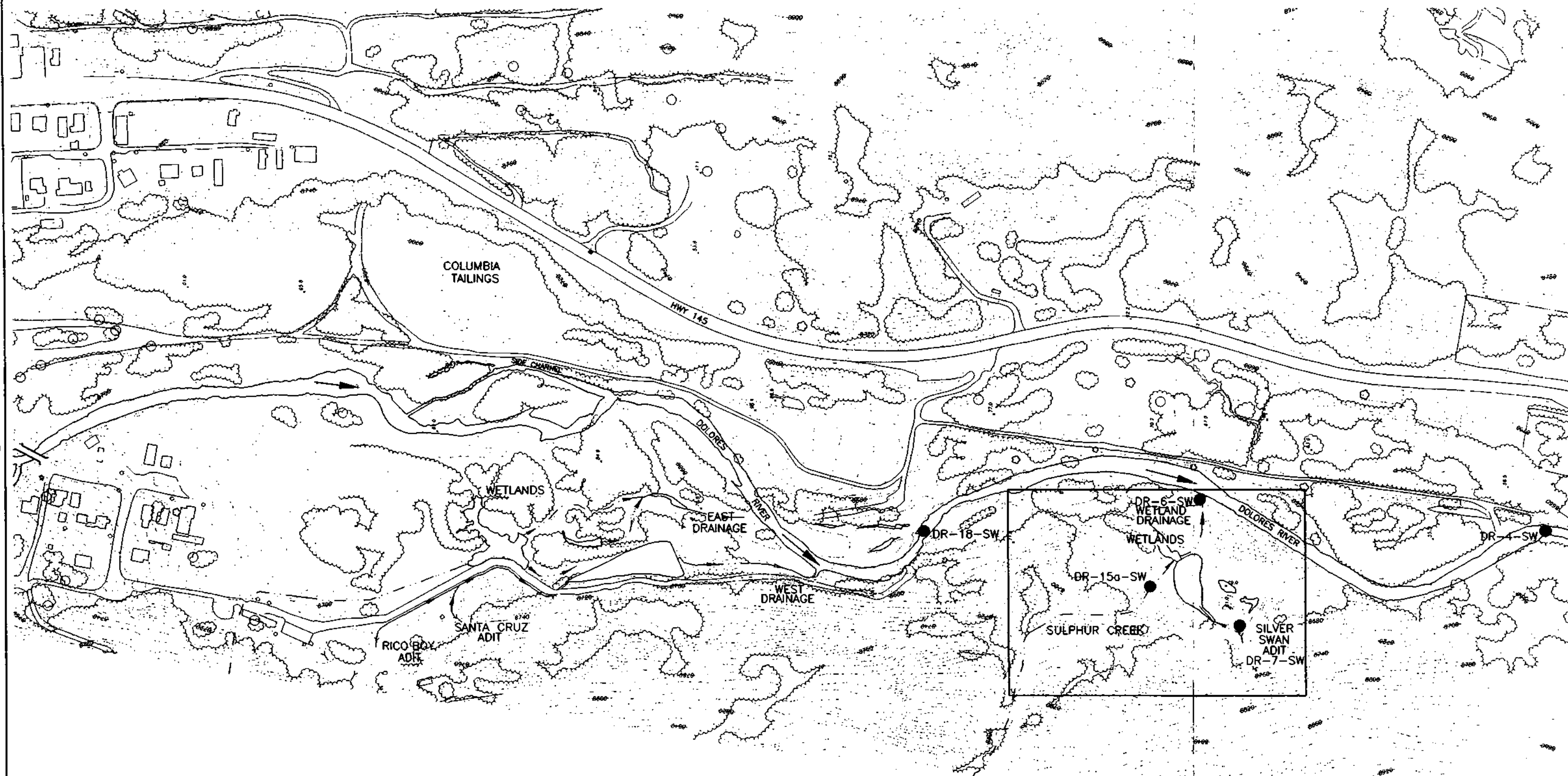
Notes:

¹ Concentrations of dissolved copper and silver were relatively low or not detected.

² Includes fall, winter, and spring sampling events. Summer values were not available for both monitoring periods.

³ Includes fall and spring pre-VCUP sampling events and spring and summer post-VCUP sampling events. Flows for these sampling events were similar.

⁴ Includes fall and spring sampling events. Winter and summer values were not available for both monitoring periods.



LEGEND

● Pre-VCUP and Post-VCUP Sampling Station



Silver Swan
Site Location Map
Figure 3-4

Average concentrations of parameters in the wetland drainage were between the average concentrations of the Silver Swan adit and Sulphur Creek (Table 3-9). Dissolved lead was the only parameter that did not follow this trend; the average concentration during post-VCUP sampling in the wetland drainage was lower than both of the influent concentration averages. Dissolved copper and silver concentrations were not detected in the wetland drainage.

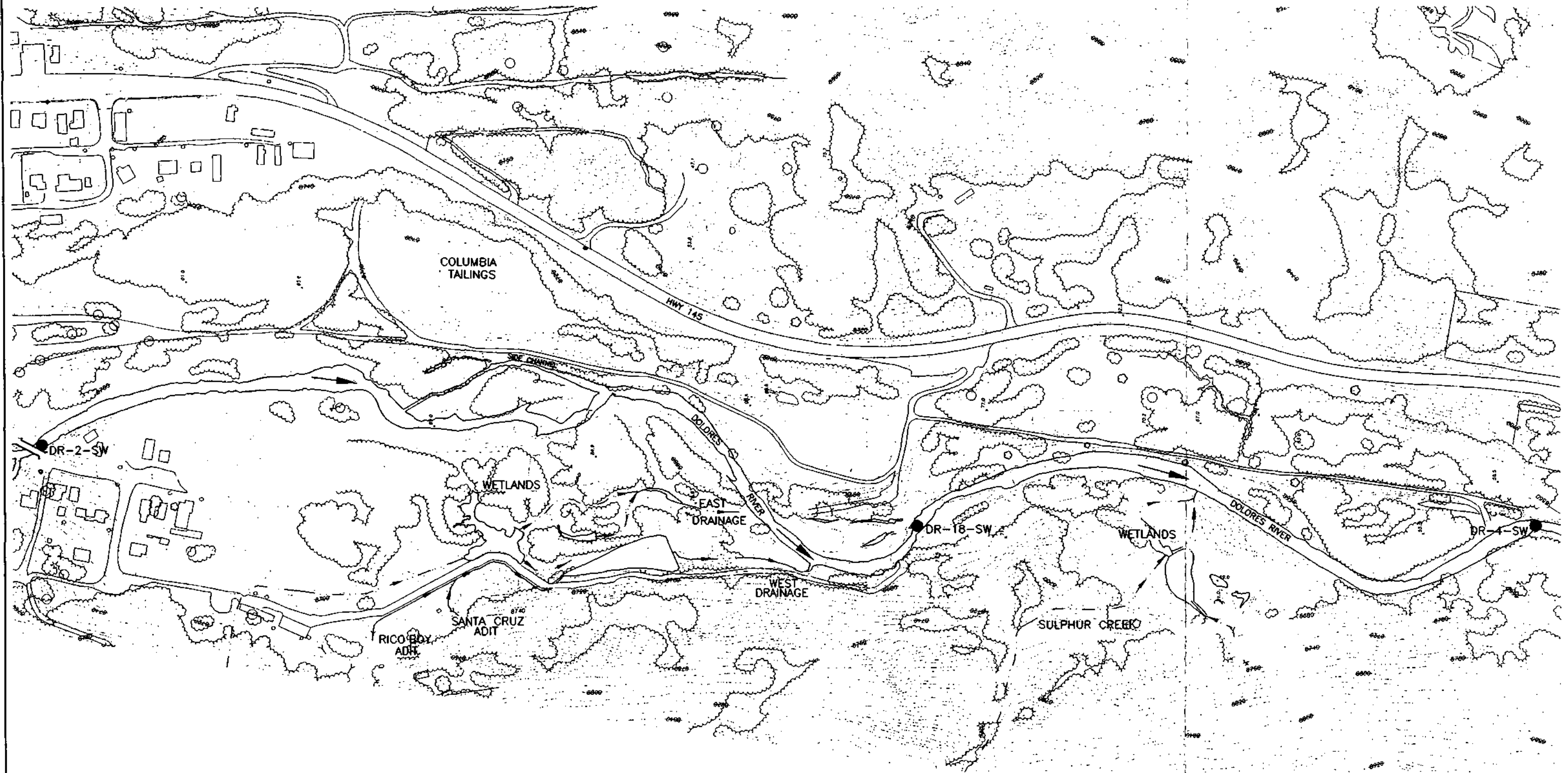
3.2.4 Dolores River

Water quality sampling was performed at three monitoring locations along the Dolores River (Figure 3-5). Stream monitoring stations were located above all the VCUP remediation sites (DR-2-SW); between the Santa Cruz and Silver Swan VCUP remediation sites (DR-18-SW); and below all VCUP remediation sites (DR-4-SW).

Dolores River flows varied seasonally from approximately 15 cfs to 262 cfs during VCUP monitoring. Measured flows at the three monitoring stations were all generally similar to each other during both sampling periods. Flow was not measured in the river during the January 1996, January 1997, and July 1997 sampling events because of ice interference in the winter and dangerously high flows in the summer. Dolores River flows during these events and during VCUP remediation activities (July 1996) were estimated from the U.S. Geological Survey gaging station No. 0916500 located approximately 4 miles downstream from Rico, Colorado (Bennet, 1997).

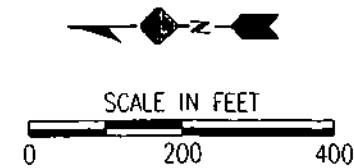
The water quality of the Dolores River was similar during pre-VCUP and post-VCUP monitoring. Most parameter concentrations were inversely proportional to measured flow. This trend can be seen in Figure 3-6 for TDS and sulfate. Values of pH were generally neutral to alkaline, ranging from 6.9 to 8.3 below the remediation sites (DR-4-SW). At the same downstream monitoring station, measured alkalinity ranged from 48 mg/L as CaCO_3 to 147 mg/L as CaCO_3 . Values of pH and concentrations of the analyzed parameters remained relatively constant from the upstream monitoring station (DR-2-SW) to the downstream stations (DR-18-SW and DR-4-SW) during both monitoring periods. Dissolved iron, manganese, and zinc were the exceptions. Average concentrations of dissolved iron and manganese increased slightly from upstream to downstream during both monitoring periods while concentrations of dissolved zinc increased slightly during pre-VCUP monitoring (Table 3-10). Although large seasonal variations were not observed during either monitoring period, increases in parameter concentrations from upstream to downstream were generally greater during the winter and spring sampling events. These seasonal variations were more pronounced during pre-VCUP sampling. Table 3-10 summarizes average parameter concentrations for the Dolores River. Concentrations of copper, lead, and silver were relatively low or not detected.

Evaluating impacts to Dolores River water quality was difficult because of large variations in flow and other variables (i.e. rain and snowmelt events) during the sampling periods. However, in addition to comparisons to applicable water quality standards, estimates of parameter loads were used to compare pre-VCUP and post-VCUP conditions. Load estimates for the Dolores River and the drainages leaving the VCUP remediation sites indicate that only drainages from the Columbia tailings site had loads high enough to impact the water quality of the Dolores River. Calculated



LEGEND

- Pre-VCUP and Post-VCUP Sampling Station



Dolores River
Water Quality Monitoring Locations
Figure 3-5

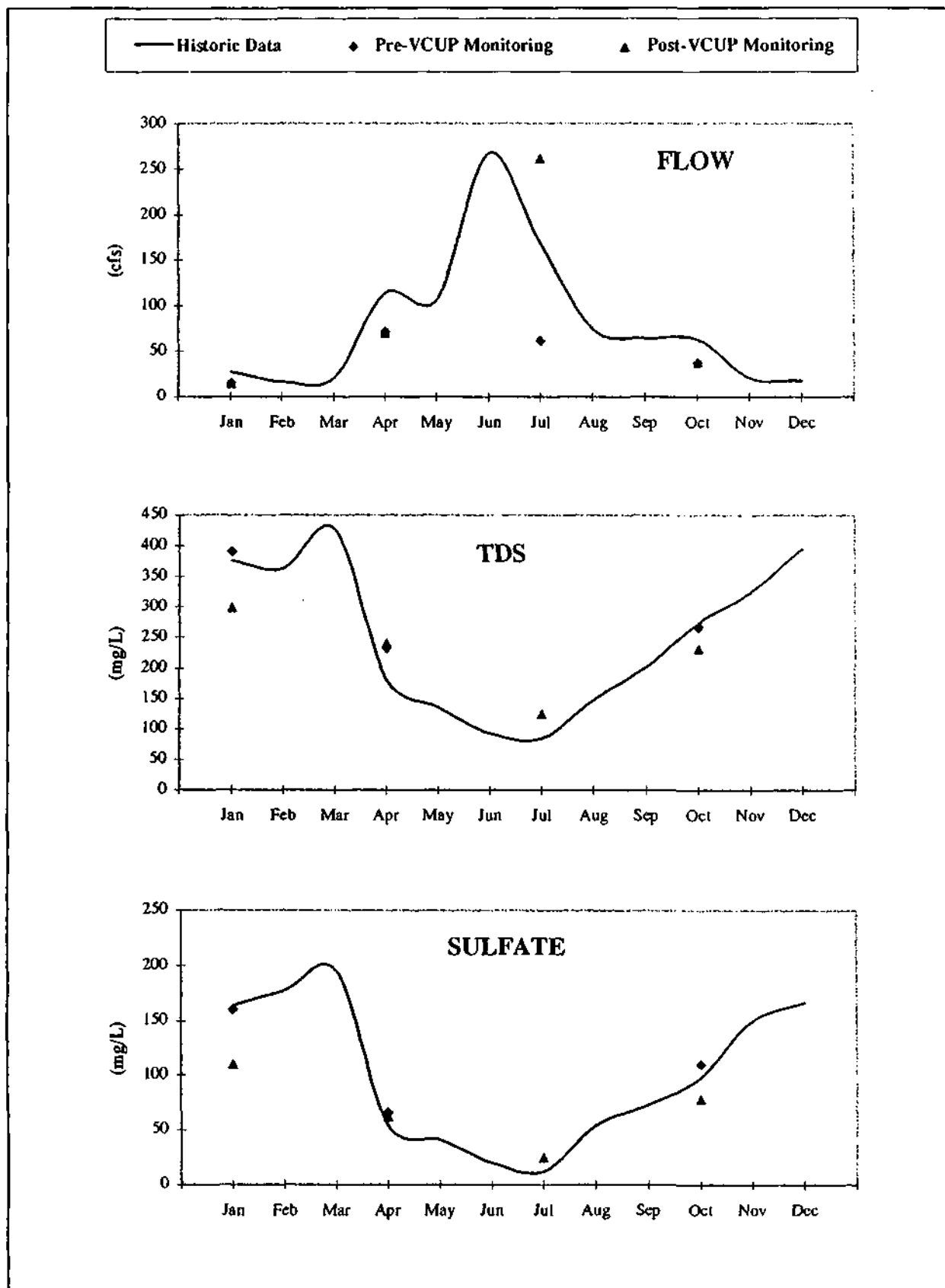


Figure 3-6 Seasonal Flow and Parameter Trends in the Dolores River (DR-4-SW)

loads for the section of the Dolores River near the Columbia tailings site (DR-2-SW to DR-18-SW) showed seasonal trends similar to those described for parameter concentrations; loads generally increased or remained the same through the river segment during the winter and spring sampling periods and decreased during the summer and fall sampling events. However, with the exception of dissolved iron, dissolved metals loads downstream from the side channel did not significantly increase during post-VCUP monitoring. During pre-VCUP monitoring, loads of dissolved iron, manganese, and zinc were higher below the side channel. This is illustrated in Figure 3-7. The ratio of loads measured in the Dolores River downstream of the side channel (DR-18-SW) to loads measured upstream of the side channel (DR-2-SW) are presented. Ratio values greater than 1 indicate that the parameter load carried by the Dolores River increased from the upstream station to the downstream station; values less than 1 indicate that parameter loads decreased from the upstream station to the downstream station.

TABLE 3-10

Dolores River Water Quality¹

Parameter ²	Upstream (DR-2-SW)		Middle (DR-18-SW)		Downstream (DR-4-SW)	
	Pre- VCUP Average	Post- VCUP Average	Pre- VCUP ³ Average	Post- VCUP Average	Pre- VCUP Average	Post- VCUP Average
Flow (cfs)	38	43	38	39	41	41
TDS (mg/L)	287	236	308	236	297	258
Sulfate (mg/L)	101	78	111	85	112	83
Alkalinity (mg/L as CaCO ₃)	122	118	112	112	111	120
Hardness (mg/L as CaCO ₃)	213	183	242	181	234	190
Dissolved Cadmium (µg/L)	0.67	0.64	0.61	0.57	— ⁴	0.59
Dissolved Iron (µg/L)	63	64	118	125	106	120
Dissolved Manganese (µg/L)	184	180	220	188	218	194
Dissolved Zinc (µg/L)	92	141	130	140	123	148

Notes:

¹ Includes fall, winter, and spring sampling events. Summer values were not available for both monitoring periods.

² Concentrations of dissolved copper, lead, and silver were relatively low or not detected.

³ Only includes winter and spring sampling events. Fall and summer values were not available for this monitoring period.

⁴ Not included because sampling event with unusually high detection limit skewed average value.

Ratio is the load measured at the downstream station (DR-18-SW) divided by the load measured at the upstream station (DR-2-SW). A ratio of more than 1 indicates that the load increased through the Dolores River stream segment.

■ Pre-Construction Ratio

◆ Post-Construction Ratio

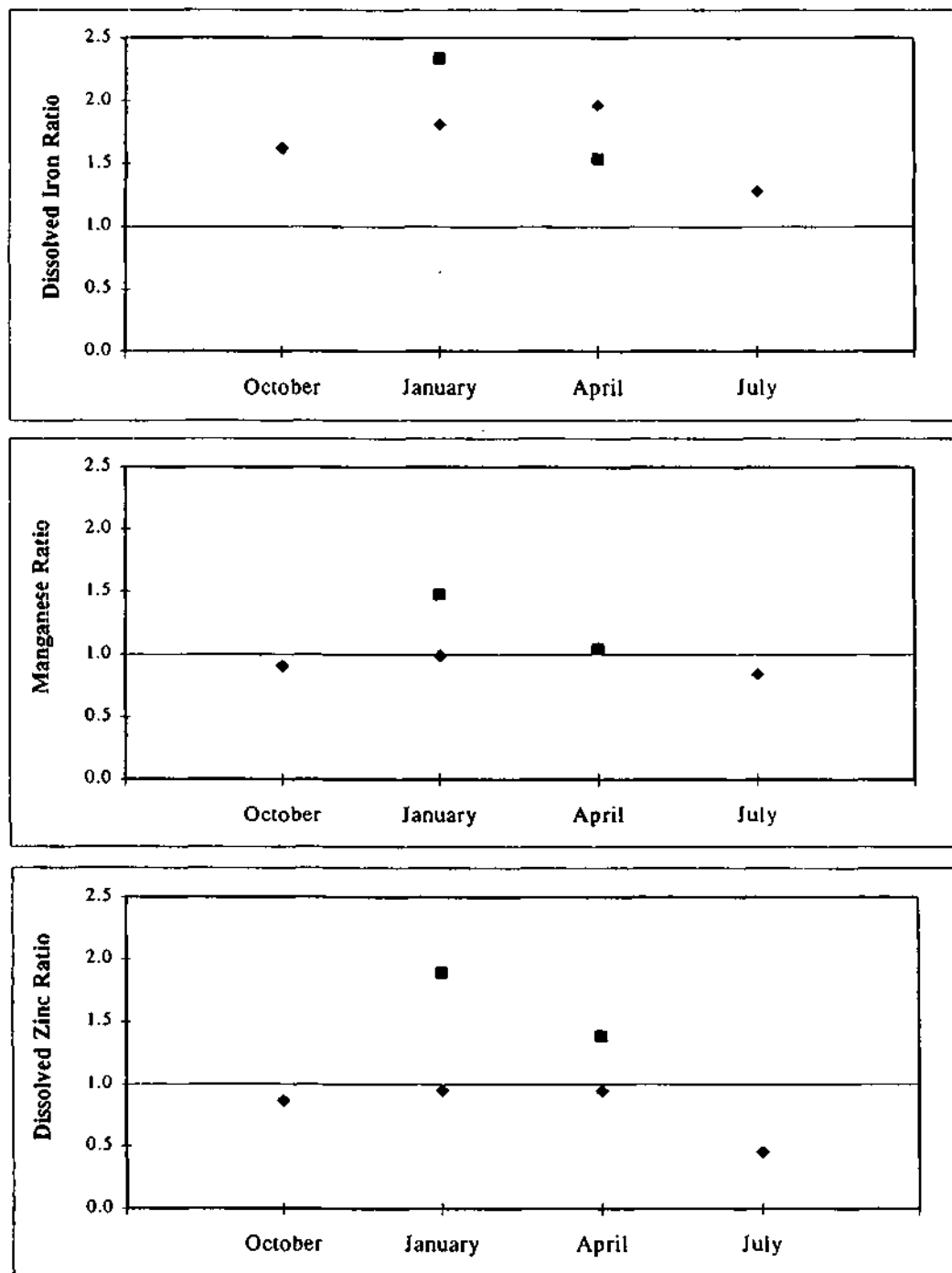


Figure 3-7 Ratios of Parameter Loads Measured in the Dolores River Upstream (DR-2-SW) and Downstream (DR-18-SW) of the Columbia Tailings Remediation Sites

Measured concentrations of dissolved metals in the Dolores River were compared to applicable water quality standards. Applicable water quality standards for the Dolores River in the vicinity of the VCUP remediation activities are listed in Table 3-11 (CDH, 1995a) and apply to both pre-VCUP monitoring data and post-VCUP monitoring data. For hardness based standards, average hardness values were calculated from pre-VCUP and post-VCUP data (Anderson, 1997).

All pre-VCUP and post-VCUP parameter concentrations measured in the Dolores River Segment No. 3 were below applicable standards. In Table 3-11, the 85th percentile value is presented for chronic standards and the maximum parameter concentration measured during VCUP monitoring is presented for acute standards. Only pre-VCUP and post-VCUP monitoring data were compared to acute standards. When comparing monitoring data to chronic standards, pre-VCUP data, post-VCUP data, and historic data since April 1984 were used to calculate the 85th percentile. Only the historic water quality data for the Dolores River subsequent to April 1984 were used because of changes in river water quality resulting from treated St. Louis tunnel drainage water (ARCO, 1996d).

TABLE 3-11
Dolores River Water Quality and Numeric Standards

Parameter ¹	Standard ($\mu\text{g/L}$) ²	85th Percentile Value or (Maximum Concentration)	Equation or Source
Cadmium, acute	19.9	(1.0)	$\text{EXP}\{1.128(\text{Ln}(\text{hardness}) - 2.905)\}$
Cadmium, chronic	1.85	0.7	$\text{EXP}\{1.128(\text{Ln}(\text{hardness}) - 2.905)\}$
Copper, acute	31.8	(< 10)	$\text{EXP}\{\text{Ln}(\text{hardness}) \times 0.9422 - 1.4634\}$
Copper, chronic	20.1	< 10	$\text{EXP}\{\text{Ln}(\text{hardness}) \times 0.8545 - 1.465\}$
Iron, chronic	1,000	112	Aquatic Life
Lead, acute	261	(0.31)	$\text{EXP}\{\text{Ln}(\text{hardness}) \times 1.6148 - 2.8736\}$
Lead, chronic	9.37	< 1.0	$\text{EXP}\{\text{Ln}(\text{hardness}) \times 1.417 - 5.167\}$
Manganese, chronic	1,000	203	Fixed in stream classification table
Silver, acute	5.92	(< 0.05)	$\text{EXP}\{\text{Ln}(\text{hardness}) \times 1.72 - 7.21\}$
Silver, chronic	0.931	< 0.1	$\text{EXP}\{\text{Ln}(\text{hardness}) \times 1.72 - 9.06\}$
Zinc, acute	198	(178)	$\text{EXP}\{\text{Ln}(\text{hardness}) \times 0.8473 - 0.8604\}$
Zinc, chronic	179	134	$\text{EXP}\{\text{Ln}(\text{hardness}) \times 0.8473 - 0.7614\}$

Notes:

¹ Values are in $\mu\text{g/L}$ and for the dissolved fraction.

² A hardness value of 186 mg/L as CaCO_3 was used for hardness based standards. The value equals the calculated mean of pre-VCUP and post-VCUP monitoring in the Dolores River Segment No. 3.

4.0 CONCLUSIONS

The following items highlight the conclusions from the first year of post-VCUP monitoring.

- **Metals Concentrations in Silver Creek and the Dolores River were Below Stream Standards.** Dissolved metals concentrations in pre-VCUP and post-VCUP samples in Silver Creek and the Dolores River did not exceed applicable stream standards during either monitoring period.
- **Metals Loads to Silver Creek Decreased.** Although decreases could have been due to normal fluctuations in water quality conditions, VCUP remediation at the Argentine tailings site may have decreased the load of dissolved metals to Silver Creek.
- **No Measured Increases in Dolores River Metals Loads after Remediation.** Increased dissolved iron loads in the Dolores River immediately downstream of the Columbia tailings side channel during post-VCUP monitoring were also measured during pre-VCUP monitoring. Dissolved manganese and zinc loads increased slightly in the river below the side channel during pre-VCUP monitoring but not during post-VCUP monitoring. Average dissolved metals loads to the Dolores River from remediation sites other than Columbia tailings were not significant.
- **Surface Water Contact with Mine Waste Reduced or Eliminated.** Uncontrolled surface water and adit drainage at the Rico Boy, Santa Cruz, and Silver Swan mine sites historically interacted with mine wastes before draining from such areas. Similar surface water drainage conditions existed at the Argentine tailings, Columbia tailings, Pro Patria tailings, and Shamrock wasterock sites. Site remediation included construction of a combination of drainage control measures to reduce or eliminate surface water contact with wastes. Specific control measures included removal of selected waste materials from drainage areas, permanent diversion of surface water away from wastes, constructed barrier systems (e.g., berms, impermeable ditch liners and revegetated caps), and drainage channel stabilization (e.g., riprap erosion protection).
- **Silver Creek and Dolores River Maintain Buffering Capacity.** During post-VCUP monitoring, values of pH in both Silver Creek and the Dolores River were generally neutral and measured alkalinity (buffering capacity) remained moderate to high. Results from all monitored drainages to Silver Creek and the Dolores River indicate that drainage from the VCUP remediation sites had neutral pH values and moderate to high alkalinity concentrations, conditions which historically have prevented the problems associated with acidic drainage waters.

- **No Measured Changes in Adit or Seep Water Quality.** Post-VCUP concentrations of measured parameters in Argentine seepage and the flow from the Rico Boy, Santa Cruz, and Silver Swan adits were similar to pre-VCUP concentrations.

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APPENDIX A

PHOTOGRAPHS OF SAMPLING STATIONS

- A1 Silver Creek Sites**
- A2 Dolores River Corridor Sites**

A1 Silver Creek Sites

SILVER CREEK SITES

SVS-5	Silver Creek upstream of Argentine Tailings
SVS-8	Silver Creek downstream of Argentine Tailings
SVS-11	Argentine Tailings seep flow above confluence with Silver Creek
SVS-12	Argentine Tailings seep at source

(Arrow denotes sampling point)

Color Photo(s)

The following pages
contain color that does
not appear in the
scanned images.

To view the actual images, please
contact the Superfund Records
Center at (303) 312-6473.

SVS-5
Silver Creek upstream
of Argentine Tailings
(4/97)

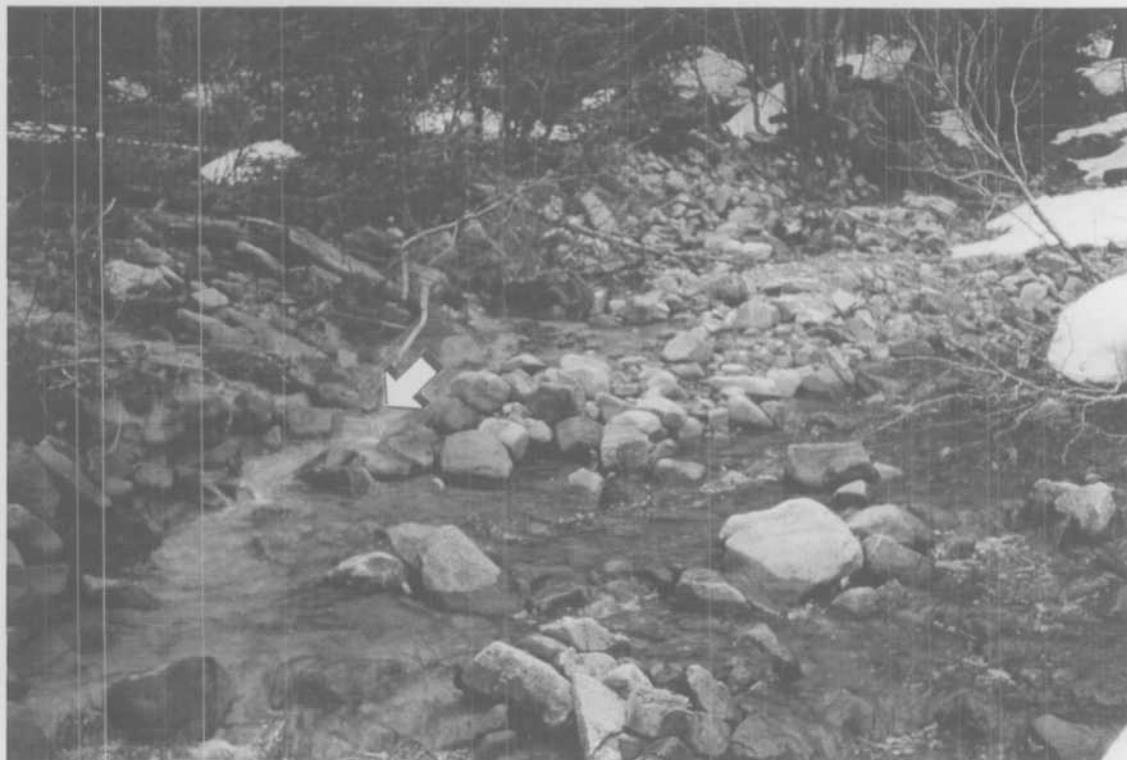
(view downstream)



SVS-8
Silver Creek downstream of Argentine Tailings
(4/97)

SVS-11

Argentine Tailings seep flow above confluence
with Silver Creek (4/97)



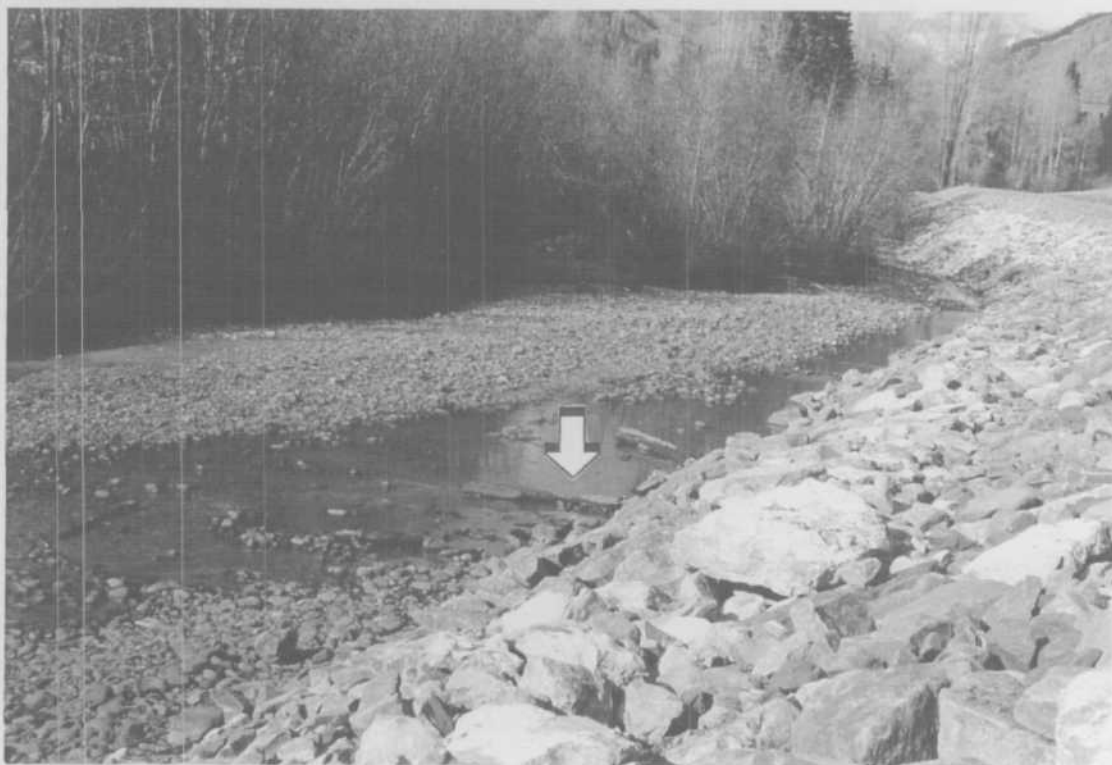
SVS-12 Argentine Tailings seep at source (4/97)

A2 Dolores River Corridor Sites

DOLORES RIVER CORRIDOR SITES

DR-1-SW	Dolores River side channel downstream from Columbia Tailings
DR-2-SW	Dolores River upstream of Santa Cruz site
DR-4-SW	Dolores River downstream of Silver Swan site
DR-6-SW	Silver Swan wetland drainage
DR-7-SW	Silver Swan Adit
DR-8-SW	Santa Cruz Adit
DR-9-SW	Santa Cruz wetland east discharge
DR-10-SW	Santa Cruz Wetland west discharge
DR-15a-SW	Sulphur Creek above discharge to Silver Swan wetland
DR-16-SW	Rico Boy Adit
DR-18-SW	Dolores River downstream of Santa Cruz site and upstream of Silver Swan site

(Arrow denotes sampling point)



DR-1-SW Dolores River side channel downstream of Columbia Tailings (4/97)
(view upstream)



DR-2-SW Dolores River upstream of Santa Cruz site (4/97)
(view upstream)



DR-4-SW Dolores River downstream of Silver Swan site (4/97)
(view upstream)



DR-6-SW Silver Swan wetland drainage (10/96)

DR-7-SW Silver Swan Adit (7/97)



DR-8-SW Santa Cruz Adit (10/96)



DR-9-SW Santa Cruz wetland east discharge (4/97)



DR-10-SW Santa Cruz wetland west discharge (7/97)
(view upstream)



DR-15a-SW Sulphur Creek above discharge to Silver Swan wetland (4/97)
(view downstream)



DR-16-SW Rico Boy Adit (10/97)



DR-18-SW Dolores River downstream of Santa Cruz site and upstream of Silver Swan site (10/97)
(view upstream)

APPENDIX B

WATER QUALITY SUMMARY TABLES

- B1 Water Quality Data Summary
 Tables by Station**
- B2 Post-VCUP Surface Water
 Sampling Field Parameters**

**B1 Water Quality Data Summary
Tables by Station**

TABLE B-1.1

**Silver Creek Upstream of Argentine Tailings
Surface Water Quality Data Summary
(Sampling Station SVS-5*)**

Date Sampled	Consultant	Flow (gpm)	pH (s.u.)	TDS (mg/L)	SO4 (mg/L)	Hardness (as CaCO3) (mg/L)	Alkalinity (as CaCO3) (mg/L)	Ag-D (ug/L)	Ag-T (ug/L)	As-T (ug/L)	Cd-D (ug/L)	Cd-T (ug/L)	Cu-D (ug/L)	Cu-T (ug/L)	Fe-D (ug/L)	Fe-T (ug/L)	Hg-T (ug/L)	Pb-D (ug/L)	Pb-T (ug/L)	Mn-D (ug/L)	Mn-T (ug/L)	Zn-D (ug/L)	Zn-T (ug/L)
30-Oct-80	Gibbs & Hill	27	7.3	200	74.9	192					10 U	26.9	10 U	10 U	50 U	460	0.3 U	50 U	50 U	160		2000	2100
19-Nov-80	Gibbs & Hill		6.8	320	197	297					20	30	10 U	20	170	2750	0.3 U	50 U	50 U	950		4600	4600
20-Apr-81	Gibbs & Hill	673	7.7	168	40.3	114			1.5		6.1	6.4	1 U	14	50 U	1910	0.05 U	1 U	7	230		1100	1500
14-May-81	Gibbs & Hill	2918	7.4	92	11.5	74			1		0.8	0.8	4	4	50 U	50 U	0.05 U	1 U	5	30		140	230
4-Jun-81	Gibbs & Hill	10549	7.4	75		49			0.1 U		0.2	0.2	5	5	50 U	200	0.05 U	1 U	1 U	10 U		50	60
24-Jun-81	Gibbs & Hill	3187	7.9	75	6.18	62			0.1 U		0.5	0.5	1 U	1 U	50 U	580	0.05 U	1 U	10	10 U		90	150
14-Jul-81	Gibbs & Hill	6374	8.0	93	19.8	72			1		2.2	3.2	5	15	50 U	150	0.05 U	3	3	20		170	200
13-Aug-81	Gibbs & Hill	763	7.2	124	32.5	106		10 U	0.1 U		7.1	8.1	1 U	1 U	110	440	0.05 U	1 U	20	50		660	700
8-Sep-81	Gibbs & Hill	1212	8.1	125	23.5	103			0.1 U		3.3	3.6	1	18	180	450	0.06	7	7	60		360	3200
5-Oct-81	Gibbs & Hill	1706	7.5	144	34.0	102			0.1 U		3.8	4.2	2	2	240	640	0.05 U	5	5	80		550	750
13-Apr-82	SRK	3142	7.0	210	82.7	141	75 F	0.05 U	0.05 U		16.7	17	1	1	50 U	14500	0.01 U	1 U	1 U	930	990	3300	3900
16-Jun-82	SRK	6329	8.0	60	5.8	60	52 F	0.05 U	0.05 U		2.8	2.8	5	6	50 U	140	0.12	1	13	10 U	10 U	30	80
13-Oct-82	SRK	642	8.0	134	17.0	105	91 F	0.05 U	0.05 U		3.4	3.4	1 U	13	170	290	0.01 U	11	11	40	40	530	600
21-May-83	SRK		8.0	88				0.1 U	0.1 U		0.4 U	1	6	7			0.05 U	1	3			10 U	10 U
14-Nov-84	EPA/FIT		6.9					5 U	5 U	10 U	5 U	5.6	5 U	5.9	49	126	0.1 U	2 U	5 U	38	37	283	329
26-Sep-95	PTI/ESA	840	7.7	117	17.0		93 L	0.02 U			2.2		10 U		95			3.9		20		423	
23-Jan-96	ESA/***NS																						
22-Apr-96	ESA	1050	8.2	166	21	117	5.8 F	0.05 U	0.05 U		3.4	4.4	10 U	10 U	42	1380		0.09 U	5.2	100	106	522	746
Argentine Tailings Site Remediation Completed in October 1996.																							
22-Oct-96	ESA	736	8.0	159	24	114	50 F	0.02 U			3.4		14		156			2.65		138		677	
21-Jan-97	ESA/***NS																						
16-Apr-97	ESA	1046	8.4	141	16	108	191 F	0.02 U			2.32		10 U		27			0.5 U		82		358	
29-Jul-97	ESA	2549	7.6	112	14	87.2	69 F	0.1 U			2.1		10 U		341			0.7		143		353	
Statistical Calculations - Undetects set to zero																							
Mean		2573		137	37	112	78	0	0.25	0	4.0	7.4	2	7	83	1601	0.01	2	6	162	235	810	1197
Standard Deviation		2781		61	46	58	53	0	0.51		5.3	9.2	4	7	101	3649	0.03	3	6	281	424	1183	1473
Number of Samples		17		19	17	17	8	11	14	1	20 **	16	20 **	16	19	15	15	20	16	19	5	20	16

D = Dissolved

CaCO3 = Calcium Carbonate

Cd = Cadmium

Hg = Mercury

SO4 = Sulfate

F = Field

T = Total recoverable

Ag = Silver

Cu = Copper

Pb = Lead

TDS = Total Dissolved Solids

L = Lab

U = Not detected; value represents detection limit

As = Arsenic

Fe = Iron

Mn = Manganese

Zn = Zinc

J = Estimated

*Also known as sampling stations S-01 and SW-02.

** Dissolved Cd and Cu results from SRK (1983) were not used to calculate the mean because of contamination during filtration.

***NS = Not Sampled due to ice/zero flow conditions

TABLE B-1.2

**Silver Creek Downstream of Argentine Tailings
Surface Water Quality Data Summary**
(Sampling Station SVS-8*)

Date Sampled	Consultant	Flow	pH	TDS	SO4	Hardness (as CaCO3)	Alkalinity (as CaCO3)	Ag-D	Ag-T	As-T	Cd-D	Cd-T	CN	Cu-D	Cu-T	Fe-D	Fe-T	Hg-T	PCE	Pb-D	Pb-T	Mn-D	Mn-T	Zn-D	Zn-T	
		(gpm)	(s.u.)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(mg/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	
12-Jun-83	SRK	5387	7.9	94	26			0.1 U	0.1 U		2	2.5		16	24	160	340	0.05		2	5	90	140	350	350	
26-Jul-83	SRK	23791	7.9	113	23			0.1 U	0.1 U		8.5	1.8		4	10			0.05 U		1 U	250			150	250	
22-Sep-83	SRK	898	7.7	205	74			0.1 U	0.1		1.4	1.8		9	11	50 U	370	0.05 U		1 U	1	440	490	500	690	
15-Dec-83	SRK			280	98			0.1 U	0.1 U		1.1	1.3		2	1 U	50 U	60	0.05 U		1 U	1	110	110	400	430	
12-Sep-84	SRK			210	57			0.1 U	0.1 U		1.1	1.8		4	6	100	770	0.05 U		1 U	1	480	530	420	710	
14-Nov-84	EPA/FIT		7.3					5 U	5 U	10 U	5 U	5 U		5 U	6.2	10 U	353	0.1 U		2 U	5 U	454	474	561	651	
14-Jul-92	USBR	2630	7.0	120					0.1 U	5	0.3 U	0.3 U		5 U	5 U	50 U	50 U	0.2 U			1 U	50 U	50 U	10 U	10 U	
15-Sep-92	USBR	898	7.5	180				10 U	10 U	10 U	5 U	5 U		25 U	25 U	330	390	0.03 U		7.6	3 U	280	320	570	610	
26-Sep-95	PTV/ESA	677	7.3	237	98	195	94 L	0.02 U	0.02 U		2.0	2.1 U		10 U	10 U	613	1030			0.42	3	588	597	1240	1340	
23-Jan-96	ESA	NM	7.7	479	230	368	92 F	0.05 U	0.05 U		2.5	2.5		10 U	10 U	734	1140			0.23 U	0.99 J	1140	1110	2330	2300	
22-Apr-96	ESA	1261	8.0	277	310	200	115 F	0.05 U	0.05 U		2.9	3.3	0.01 U	10 U	10 U	125	847		0.5 U	0.05 U	3.5	406	402	955	1100	
Argentine Tailings Site Remediation Completed in October 1996.																										
22-Oct-96	ESA	1043	8.0	190	64	151	101 F	0.02 U			2.28			10 U		141				0.88		392		738		
21-Jan-97	ESA	NM	8.9	237	81	184	115 F	0.02 U			1.78			10 U		148				0.5 U		615		840		
16-Apr-97	ESA	1019	7.2	236	72	174	86 F	0.02 U			2.16			10 U		40				0.5 U		403		633		
29-Jul-97	ESA	2715	7.5	178	36	112	70 F	0.1 U			1.8			10 U		101				0.6		235		347		
Statistical Calculations - Undetects set to zero																										
Mean		4033		217	97	198	96	0	0.01	2	1.5	1.4	0	0.4	5.2	178	532	0.01	0	0.8	24.1	402	417	669	713	
Standard Deviation		7090		95	86	81	16	0	0.03	3	1.1	1.2		1.2	7.6	229	397	0.02		2.0	74.9	280	314	555	665	
Number of Samples		10		14	12	7	7	14	11	3	11 **	11	1	11 **	11	14	10	8	1	14	11	14	10	15	11	

D = Dissolved

CaCO₃ = Calcium Carbonate

Cd = Cadmium

Hg = Mercury

SO₄ = Sulfate

F = Field

CN = Cyanide

T = Total recoverable

Ag = Silver

Cu = Copper

Pb = Lead

TDS = Total Dissolved Solids

L = Lab

PCE = Tetrachloroethylene

U = Not detected; value represents detection limit

As = Arsenic

Fe = Iron

Mn = Manganese

Zn = Zinc

J = Estimated

NM = Not measured - Ice conditions in channel

* Also known as sampling stations DR43T, S-02B, SW-03, S-2B, and S2B.

** Dissolved Cd and Cu results from SRK (1983) were not used to calculate the mean because of contamination during filtration.

TABLE B-1.3
Argentine Tailings Seep Flow above Confluence with Silver Creek
Water Quality Data Summary
(Sampling Station SVS-11)

Date Sampled	Consultant	Flow (gpm)	pH s.u.	TDS (mg/L)	SO4 (mg/L)	Hardness (as CaCO3) (mg/L)	Alkalinity (as CaCO3) (mg/L)	Ag-D (ug/L)	Ag-T (ug/L)	As-T (ug/L)	Cd-D (ug/L)	Cd-T (ug/L)	CN (mg/L)	Cu-D (ug/L)	Cu-T (ug/L)	Fe-D (ug/L)	Fe-T (ug/L)	Hg-T (ug/L)	PCE (ug/L)	Pb-D (ug/L)	Pb-T (ug/L)	Mn-D (ug/L)	Mn-T (ug/L)	Zn-D (ug/L)	Zn-T (ug/L)	
26-Sep-95	PTV/ESA	NM	7.2	1090	560	722	100 L	0.02 U	0.02 U		2.15	2.14 U		10 U	10 U	14300	15800			0.07	4.88	8210	8330	10800	11700	
23-Jan-96	ESA	NM	7.7	742	400	543	180 F	0.05 U	0.05 U		1.08	1.14		10 U	10 U	5630	6390			0.39 U	1.66 J	5700	5390	6750	6790	
22-Apr-96	ESA	NM	7.7	1060	570	781	152 F	0.05 U	0.05 U		1.69	1.64	0.02 U	10 U	10 U	47	156		0.5 U	0.08 U	1.33	2060	2090	2190	2230	
Argentine Tailings Site Remediation Completed in October 1996.																										
22-Oct-96	ESA	43	7.6	832	510	618	98 F	0.02 U			2.12			10 U		5080				0.04 U		6880		5410		
21-Jan-97	ESA	54	8.3	972	560	595	110 F	0.02 U			2.12			10 U		53				0.5 U		3610		2190		
16-Apr-97	ESA	NM	7.6	1050	570	761	127 F	0.02 U			1.94			10 U		2100				0.5 U		6260		4170		
29-Jul-97	ESA	49J	7.3	1170	690	792	133 F	0.1 U			1.90			10 U		2260				0.5 U		6690		3620		
Statistical Calculations - Undetects set to zero																										
Mean		49		979	551	687	129	0	0		1.86	0.93	0	0	0	4210	7449		0	0.01	2.62	5630	5337	5019	6907	
Standard Deviation		5		146	86	100	30	0	0		0.38	0.84		0	0	4957	7816			0.03	1.96	2104	3128	3035	4736	
No. of Samples		3		7	7	7	7	3	3		7	3	1	7	3	7	3		1	7	3	7	3	7	3	

D = Dissolved

T = Total recoverable

U = Not detected; value represents detection limit

J = Estimated

CaCO₃ = Calcium Carbonate

Ag = Silver

As = Arsenic

NM = Not measured - Flow is not channelized at this station.

Cd = Cadmium

Cu = Copper

Fe = Iron

Hg = Mercury

Pb = Lead

Mn = Manganese

SO₄ = Sulfate

TDS = Total Dissolved Solids

Zn = Zinc

F = Field

L = Lab

CN = Cyanide

PCE = Tetrachloroethylene

TABLE B-1.4
Argentine Tailings Seep at Source
Water Quality Data Summary
 (Sampling Station SVS-12*)

Date Sampled	Consultant	Flow (gpm)	pH (a.u.)	TDS (mg/L)	SO4 (mg/L)	Hardness (as CaCO3) (mg/L)	Alkalinity (as CaCO3) (mg/L)	Ag-D (ug/L)	Ag-T (ug/L)	As-T (ug/L)	Cd-D (ug/L)	Cd-T (ug/L)	CN (mg/L)	Cu-D (ug/L)	Cu-T (ug/L)	Fe-D (ug/L)	Fe-T (ug/L)	Hg-T (ug/L)	PCE (ug/L)	Pb-D (ug/L)	Pb-T (ug/L)	Mn-D (ug/L)	Mn-T (ug/L)	Zn-D (ug/L)	Zn-T (ug/L)	
30-Oct-80	Gibbs & Hill	18	7.9	896	474	741					10 U	10 U		10 U	10 U	140	150	0.3 U		50 U	50 U	5010		2800	2800	
19-Nov-80	Gibbs & Hill	18	7.5	904	462	635					10 U	10		10 U	20	50 U	2920	0.3 U		50 U	50 U	5900		3600	4300	
20-Apr-81	Gibbs & Hill	4.5	7.5	880	539	681		0.8		2.3	2.3			2	13	50 U	390	0.09		1 U	1 U	180		900	1100	
14-May-81	Gibbs & Hill	67	7.2	1564	960	1096		0.1 U		23	37			5	13	50 U	340	0.05 U		1 U	1 U	4950		4900	4900	
21-May-81	Dames & Moore				862	1054	165 L			10 U	20	20		10 U	10 U	100	520	0.3 U		50 U	10 U	5300	5900	4600	4600	
4-Jun-81	Gibbs & Hill	67	7.0	1077	767	863		0.1 U		10	11			3	4	50 U	1550	0.05 U		1 U	1 U	5400		4700	5000	
24-Jun-81	Gibbs & Hill	36	7.2	1193	752	867		0.1 U		5.4	5.4			1 U	1 U	50 U	820	0.05 U		1 U	1 U	5800		3100	3800	
14-Jul-81	Gibbs & Hill	40	7.4	1082	564	739		0.1 U		8.7	8.7			1 U	1 U	50 U	1230	0.09		1 U	1 U	6300		3700	4400	
13-Aug-81	Gibbs & Hill	45	7.2	1110	651	789		0.4		13	13			1 U	25	680	4800	0.05 U		9	25	7500		4600	4800	
8-Sep-81	Gibbs & Hill	45	7.8	900	556	647		0.1 U		5.4	6.5			1 U	3	510	1420	0.05 U		2	2	6200		3300	3800	
5-Oct-81	Gibbs & Hill	45	7.8	984	587	697		0.1 U		6	6			1 U	1 U	50 U	1600	0.05 U		1 U	6	6500		3500	3800	
13-Apr-82	SRK	45	7.7	1430	864	984	162 F	0.05 U	0.05 U		10	10.5		1 U	1 U	130	1980	0.01 U		1 U	1 U	7000	7400	5700	6200	
16-Jun-82	SRK	44	7.9	1520	908	1054	168 F	0.11	0.11		10	18		5	14	250	2840	0.01 U		1 U	6	10200	10200	6300	6700	
13-Oct-82	SRK	30	7.2	1396	847	993	121 F	0.05 U	0.05 U		8.5	11.1		3	3	3050	5100	0.01 U		1 U	4	10600	11700	9000	9800	
14-Nov-84	EPA/FTI		6.3					5 U	3 U	3.6	5 U	7.5		5 U	15	16500	22900	0.1 U		5 U	130	11200	12500	10800	11800	
1-Jun-95	PTI/ESA	40	6.4	1730		1320	144 F	0.07		2	5	6		10 U	20	17600	20600	0.5 U		9.2	99.7	12400	12400	15100	15000	
26-Sep-95	PTI/ESA	44	7.0			733		0.02 U	0.02 U		2.4	2.1 U		10 U	10 U	17500	18700			1.7	6.5	8600	8490	11400	12000	
23-Jan-96	ESA	26	6.9	716	380	516	236 F	0.08	0.1		0.9	0.9	0.04	10 U	10 U	10500	12200		0.5 U	1.88	26 J	5900	5760	7880	7670	
22-Apr-96	ESA	45	7.0	1130	670	803	45 F	0.05 U	0.44 J		2.43	2.46	0.02	10 U	40 J	10800	18200 J		0.5 U	0.3 J	220 J	8240	8270	9490	9690	
Argentine Tailings Site Remediation Completed in October 1996.																										
22-Oct-96	ESA	43	7.1	760	390	533	116 F	0.02 U			3.45		0.01 U	10 U		5880			0.5 U	1.02		4990		5530		
21-Jan-97	ESA	54	7.6	662	330	444	130 F	0.02 U			0.58			10 U		10200				2.0		5250		4710		
16-Apr-97	ESA	49	6.7	1010	550	703	150 F	0.02 U			0.76			10 U		12200				1.1		8010		6690		
29-Jul-97	ESA	58	6.5	1090	480	710	138 F	0.1 U			0.5		0.01 U	10 U		11900				5.9		7250		5890		
Statistical Calculations - Undetects set to zero																										
Mean		41		1102	630	800	161	0.02	0.09	1.9	6.0	9.2	0.02	0.8	8.9	5128	6224	0.01	0	1.5	27.6	6899	9180	6008	6429	
Standard Deviation		15		294	190	213	41	0.04	0.22	1.8	6.3	8.8	0.02	1.6	11.3	6570	7894	0.03	0	2.8	58.8	2591	2639	3291	3639	
No. of Samples		21		20	20	22	11	12	15	3	23	19	4	23	19	23	19	16	3	23	19	23	9	23	19	

D = Dissolved
T = Total recoverable
U = Not detected; value represents detection limit
J = Estimated

CaCO3 = Calcium Carbonate
Ag = Silver
As = Arsenic

Cd = Cadmium
Cu = Copper
Fe = Iron

Hg = Mercury
Pb = Lead
Mn = Manganese

SO4 = Sulfate
TDS = Total Dissolved Solids
Zn = Zinc

F = Field
L = Lab

CN = Cyanide
PCE = Tetrachloroethylene

*Also known as sampling stations S-02A, SW-04, Argentine Tails A, S-02, and RA-SW-04.

TABLE B-1.5
Dolores River Side Channel Side Channel Downstream of Columbia Tailings
Water Quality Data Summary
(Sampling Station DR-1-SW)

Date Sampled	Consultant	Flow (gpm)	pH (s.u.)	TDS (mg/L)	SO ₄ (mg/L)	Hardness (as CaCO ₃) (mg/L)	Alkalinity (as CaCO ₃) (mg/L)	Ag-D (ug/L)	Ag-T (ug/L)	Cd-D (ug/L)	Cd-T (ug/L)	CN (mg/L)	Cu-D (ug/L)	Cu-T (ug/L)	Fe-D (ug/L)	Fe-T (ug/L)	Pb-D (ug/L)	Pb-T (ug/L)	Mn-D (ug/L)	Mn-T (ug/L)	Zn-D (ug/L)	Zn-T (ug/L)
16-Oct-95	PTI/ESA	100	6.6	358	360	258	105 L	0.02 U	0.02 U	9.25	8.21		19	39	9290	11400	0.26	12.7	2070	2150	2760	2820
25-Jan-96	ESA	NM	7.1	404	170	302	123 F	0.05	0.05	6.2	5.6		17	17	5430	5900	5.76	6.11 J	1000	1030	1610	1650
23-Apr-96	ESA	193	6.0	417	180	309	70 F	0.05 U	0.05 U	9.86	9.57	0.01 U	31	81	8030	12200	0.21 UJ	13	2220	2170	3100	3110
Dolores River Corridor Remediation Completed in October 1996.																						
23-Oct-96	ESA	169	6.5	296	130	214	97 F	0.02 U		5.32		0.01 U	15		6090		1.09		1660		1950	
22-Jan-97	ESA	238	7.0	353	150	256	177 F	0.02 U		5.03			13		6090		0.60		1350		1810	
17-Apr-97	ESA	61	6.2	478	230	345	125 F	0.02 U		10.7			61		12900		2.75		3380		4390	
30-Jul-97	ESA	34829	7.2	122	20	67.2	44 F	0.1 U		0.2			10 U		98		0.5 U		66		65	
Statistical Calculations - Undetects set to zero																						
Mean		5932		347	177	250	106	0.01	0.02	6.7	7.8	0	22	46	6847	9833	1.49	10.6	1678	1783	2241	2527
Standard Deviation		14157		115	103	91	43	0.02	0.03	3.6	2.0		19	33	3931	3430	2.11	3.9	1042	652	1356	773
No. of Samples		6		7	7	7	7	7	3	7	3	2	7	3	7	3	7	3	7	3	7	3

D = Dissolved

T = Total recoverable

U = Not detected; value represents detection limit

J = Estimated

CaCO₃ = Calcium Carbonate

Ag = Silver

As = Arsenic

NM = Not measured - Ice conditions in channel.

Cd = Cadmium

Cu = Copper

CN = Cyanide

Fe = Iron

Pb = Lead

Mn = Manganese

SO₄ = Sulfate

TDS = Total Dissolved Solids

Zn = Zinc

F = Field

L = Lab

TABLE B-1.6
Dolores River Upstream of Santa Cruz Site
Water Quality Data Summary
 (Sampling Station DR-2-SW*)

Date Sampled	Consultant	Flow (cfs)	pH (s.u.)	TDS (mg/L)	SO4 (mg/L)	Hardness (as CaCO3) (mg/L)	Alkalinity (as CaCO3) (mg/L)	Ag-D (ug/L)	Ag-T (ug/L)	As-T (ug/L)	Cd-D (ug/L)	Cd-T (ug/L)	Cu-D (ug/L)	Cu-T (ug/L)	Fe-D (ug/L)	Fe-T (ug/L)	Hg-T (ug/L)	Pb-D (ug/L)	Pb-T (ug/L)	Mn-D (ug/L)	Mn-T (ug/L)	Zn-D (ug/L)	Zn-T (ug/L)
20-Nov-80	Gibbs & Hill	21	6.8	500	217	403					10 U	10 U	10 U	10 U	50 U	240	0.3 U	50 U	50 U	670		420	420
16-Dec-80	Gibbs & Hill	14	6.9	400	179						10 U	10 U	10 U	10 U	50 U	130	0.3 U	50 U	50 U	450		600	600
20-Jan-81	Gibbs & Hill	17	7.1	408	192	328					10	10 U	10 U	10 U	50 U	320	0.3 U	50 U	50 U	430		200	200
26-Feb-81	Gibbs & Hill	9.0	6.9	432	209	332			0.2		10 U	10 U	10 U	10 U	60	500	0.3 U	50 U	50 U	500		190	190
25-Mar-81	Gibbs & Hill	16	7.1	444	180	353			0.1 U		1 U	2	1 U	1 U	50 U	510	0.05 U	1 U	1 U	510		150	170
22-Apr-81	Gibbs & Hill	100	7.0	124	33.7	114			0.1 U		0.8	0.8	1 U	1 U	50 U	820	0.29	1 U	1 U	90		60	100
13-May-81	Gibbs & Hill	102	7.1	124	33.7	96.78			0.1 U		0.7	0.7	1 U	1 U	50 U	200	0.25	1	1	90		80	110
3-Jun-81	Gibbs & Hill	446	7.1	71	9.87	47			0.3		0.1	0.1	1 U	27	50 U	1070	0.35	1 U	1 U	20		30	30
24-Jun-81	Gibbs & Hill	92	7.0	113	32.5	95			2.3		0.1 U	0.1 U	1 U	1 U	50 U	50	0.05 U	1 U	1 U	50		70	70
14-Jul-81	Gibbs & Hill	171	7.2	107	32.5	78			0.1 U		1.7	2	1	1	50 U	1760	0.05 U	1 U	1 U	30		40	530
12-Aug-81	Gibbs & Hill	71	7.2	159	53.9	120		10	0.5		3.1	3.6	1 U	1 U	50 U	410	0.05 U	1 U	1 U	80		50	90
10-Sep-81	Gibbs & Hill	57	6.9	190	63.4	148			0.1 U		0.4	1.2	1 U	1 U	50 U	580	0.27	1 U	1 U	130		80	90
5-Oct-81	Gibbs & Hill	90	7.2	190	61.6	137			0.1 U		0.5	1	1 U	1 U	50 U	530	0.05 U	1 U	1 U	120		80	120
13-Apr-82	SRK	95	6.5	190	58.4	161	110 F	0.05 U	0.2		3.9	4.5	16	16	2170	2640	0.01 U	10	10	330	380	500	960
17-Jun-82	SRK	469	7.9	70	16.9	54	44 F	0.05 U	0.05 U		2.2	4.3	19	20	50 U	560	0.03	1 U	15	30	60	40	110
13-Oct-82	SRK	70	7.5	226	70	160	96 F	0.05 U	0.05 U		1.2	1.2	1 U	1 U	80	160	0.01 U	1 U	3	200	210	160	230
25-Jan-83	SRK	14	7.0	364	134	270	151 L	0.05 U	0.05 U		1.5	1.4	2	3	50	270	0.01 U	1 U	1 U	420	420	200	300
23-Feb-83	SRK	17	7.1	374	154			0.1 U	0.1 U		1.1	1.8	1 U	3			0.05 U	1 U	1 U			230	230
17-Mar-83	SRK	27	7.0	273	111			0.1 U	0.1 U		1.7	0.5	2	2	70	180	0.05 U	1 U	2	290	290	190	190
26-Apr-83	SRK	150	7.0	146	54			0.1 U	0.1 U		1.3	1.3	1 U	10			0.05 U	1 U	5			200	250
21-May-83	SRK	137	7.3	196	53			0.1 U	0.1 U		1.2	1.4	21	7			0.05 U	2	3			160	160
12-Jun-83	SRK	925	7.2	71	18			0.1 U	0.1 U		1.2	1.6	7	7	200	720	0.05 U	1	3	70	70	90	430
26-Jul-83	SRK	269	7.2	111	54			0.1 U	0.1 U		3.7	1.3	4	8			0.05 U	1	5			90	80
30-Aug-83	SRK	81	7.4	135	50			0.1 U	0.1 U		1.7	1	6	6			0.05 U	1 U	5			140	240
22-Sep-83	SRK	45	7.1	238	101			0.1 U	0.1 U		0.6	1.1	9	8	50 U	210	0.05 U	1 U	1 U	290	290	200	200
19-Oct-83	SRK			233	93			0.1 U	0.1 U		1	0.9	7	2			0.05 U	1 U	1			150	150
16-Nov-83	SRK	37	7.4	370	146			0.1 U	0.1 U		1.9	1.8	6	3	50 U	260	0.05 U	1 U	1 U	390	390	190	190
14-Dec-83	SRK			361	123			0.1 U	0.1 U		0.8	0.8	4	3	80	290	0.05 U	1 U	1 U	390	390	220	230
19-Jan-84	SRK			345	120			0.1 U	0.1 U		1.5	0.7	6	1			0.05 U	1	3			200	190
27-Mar-84	SRK			262	87			0.1 U	0.1 U		21	0.9	45	1 U	50 U	330	0.05 U	1 U	1 U	150	170	160	150
1-Jun-84	SRK			74	12			0.1 U	0.1 U		0.8	0.4	32	4	50	930	0.05 U	1 U	5	50	50	50	60
12-Sep-84	SRK			219	70			0.1 U	0.1 U		0.5	0.7	1 U	2	50	230	0.05 U	1 U	1 U	120	140	50	80
14-Nov-84	EPA/FIT		6.7					5 U	5 U	10 U	5 U	5 U	5 U	8	40	199	0.1 U	2 U	5 U	140	141	90	74
6-Dec-84	SRK			267	86			0.1 U	0.1 U		0.4 U	0.4 U	1 U	1 U	50 U	310	0.05 U	1 U	1 U	160	170	60	70
8-Sep-93	USBR	43	6.8					2.2 U	2.2 U	0.6 U	1.4 U	1.4 U	3.5 U	3.5 U	106	192	0.074 U	7.6 U	7.6 U	130	136	14.2	58.6
16-Oct-95	PTV/ESA	45	7.3	286	110	208	110 L	0.02 U	0.02 U		0.65	0.43	10 U	10 U	63	142		0.31	0.57	197	195	102	87
25-Jan-96	ESA	NM	6.3	325	120	248	170 F	0.05 U	0.05 U		0.99	0.44	10 U	10 U	66	145		0.64 U	1.0 J	203	228	74	80
23-Apr-96	ESA	53	6.4	250	72	184	85 F	0.05 U	0.05 U		0.38	0.40	10 U	10 U	60	200		0.15 U	0.6	153	164	99	103
Dolores River Corridor Remediation Completed in October 1996.																							
24-Oct-96	ESA	41	7.5	228	80	169	121 F	0.02 U			0.59		10 U		57			0.12 U		172		123	
23-Jan-97	ESA	NM	8.2	301	100	217	112 F	0.03 U			0.76		10 U		80			0.5 U		259		173	
18-Apr-97	ESA	74	7.0	178	55	163	122 F	0.02 U			0.57		10 U		56			0.5 U		109		128	
30-Jul-97	ESA****	262	7.3	142	26	83	47 F	0.1 U			0.3		10 U		53			0.5 U		62		90	
Statistical Calculations - Undetects set to zero**																							
Mean		86		227	73	182	110	0.00	0.00	0	0.46	0.30	2.7	1.8	57	294	0.00	0.03	0.90	146	153	88	77
Standard Deviation		87		77	35	53	38	0.00	0.00	0	0.33	0.26	9.2	2.9	25	263	0.00	0.09	1.7	59	52	42	15
No. of Samples		6		10	10	7	7	12	8	2	12	8	12	8	12	8	4 ***	12	8	12	8	12	8

D = Dissolved CaCO3 = Calcium Carbonate Cd = Cadmium Hg = Mercury SO4 = Sulfate F = Field
 T = Total recoverable Ag = Silver Cu = Copper Pb = Lead TDS = Total Dissolved Solids L = Lab
 U = Not detected; value represents detection limit As = Arsenic Fe = Iron Mn = Manganese
 J = Estimated NM = Not measured - Ice conditions in channel

* Also known as sampling stations D-06, DR49T, and SW-08.

** The St. Louis Ponds Water Treatment Plant began operating in April 1984. Prior data was excluded in calculations.

*** Excluded 1989-91 and 1993 data from Bureau of Reclamation report due to problems with data quality.

**** Preliminary flow rates collected from inactive USGS gaging station 4 miles southeast of Rico.

TABLE B-1.7

**Dolores River Downstream of Silver Swan Site
Water Quality Data Summary
(Sampling Station DR-4-SW*)**

Date Sampled	Consultant	Flow (cfs)	pH (a.u.)	TDS (mg/L)	SO4 (mg/L)	Hardness (as CaCO3) (mg/L)	Alkalinity (as CaCO3) (mg/L)	Ag-D (ug/L)	Ag-T (ug/L)	As-T (ug/L)	Cd-D (ug/L)	Cd-T (ug/L)	Cu-D (ug/L)	Cu-T (ug/L)	Fe-D (ug/L)	Fe-T (ug/L)	Hg-T (ug/L)	Pb-D (ug/L)	Pb-T (ug/L)	Mn-D (ug/L)	Mn-T (ug/L)	Zn-D (ug/L)	Zn-T (ug/L)
29-Oct-80	Gibbs & Hill	36	7.1	300	116						10 U	10 U	10 U	10 U	50 U	50 U	0.3 U	50 U	50 U	280		200	200
18-Nov-80	Gibbs & Hill	21	7.3	324	150						10 U	10 U	10 U	30	50 U	630	0.3 U	50 U	50 U	480		280	380
15-Dec-80	Gibbs & Hill	18	7.3	396	167						10 U	10 U	10 U	10	50 U	260	0.3 U	50 U	50 U	470		320	320
19-Jan-81	Gibbs & Hill	28	7.3	376	164	324					10 U	10 U	10 U	10 U	70	340	0.3 U	50 U	50 U	410		220	230
25-Feb-81	Gibbs & Hill	17	7.5	364	178	302			1470		10 U	10 U	10 U	10 U	50 U	270	0.3 U	50 U	50 U	250		180	180
26-Mar-81	Gibbs & Hill	12	7.6	500	250	411			0.1 U		2	3	1	1	50 U	260	0.05 U	1 U	1 U	530		310	340
22-Apr-81	Gibbs & Hill	95	6.9	176	47.7	121			0.1		0.9	1.2	1 U	1 U	50 U	730	0.05 U	1 U	1 U	110		120	150
13-May-81	Gibbs & Hill	107	7.3	136	41.2	102			0.1 U		0.5	0.5	26	26	50 U	200	0.48	1 U	1 U	90		100	220
3-Jun-81	Gibbs & Hill	431	6.9	69	9.87	48			0.1 U		0.2	0.3	1 U	12	50 U	1180	0.05 U	1 U	1	20		60	60
24-Jun-81	Gibbs & Hill	104	7.3	118	30.9	95			0.1 U		0.2	0.2	1 U	1	50 U	50	0.05 U	1 U	1 U	50		60	80
16-Jul-81	Gibbs & Hill	170	7.7	85	12.3	68			0.2		0.1 U	0.1	15	15	70	6800	0.05 U	1 U	1 U	30		40	50
12-Aug-81	Gibbs & Hill	75	7.4	148	34	129		10	0.7		3.6	3.6	10	10	50 U	960	0.05 U	1 U	54	120		130	210
11-Sep-81	Gibbs & Hill	65	7.3	203	72.8	159			0.1 U		0.5	0.8	1	1	50 U	550	0.05 U	1 U	4	170		140	140
5-Oct-81	Gibbs & Hill	85	7.1	205	68.6	149			0.1 U		1	0.3	1 U	1 U	50 U	810	0.05 U	3	3	140		100	160
14-Apr-82	SRK	135	7.1	190	60.7	156	107 F	0.05 U	0.05 U		1.9	2.3	7	7	50 U	2440	0.01 U	1 U	4	160	280	260	290
17-Jun-82	SRK		8.1	74	20.6	64	42 F	0.05 U	0.05 U		1.4	1.8	8	8	80	770	0.06	1 U	2	50	50	70	160
14-Oct-82	SRK	70	7.0	316	110	183	103 F	0.05 U	0.05 U		1	1.3	1 U	1 U	110	400	0.01 U	3	3	300	320	290	340
17-Mar-83	SRK	30	7.2	354	139			0.1 U	0.1 U		1.2	1	2	4	50 U	180	0.05 U	1	1	370	380	280	300
12-Jun-83	SRK		7.5	101	29			0.1 U	0.1 U		1.2	1.3	1	5	190	900	0.05 U	2	3	70	80	160	420
22-Sep-83	SRK		7.3	252	106			0.1 U	0.1 U		0.8	1.1	10	12	50 U	320	0.05 U	1 U	1 U	340	340	240	260
15-Dec-83	SRK			359	120			0.1 U	0.1 U		1	0.9	2	1 U	170	340	0.05 U	1 U	7	390	400	250	260
27-Mar-84	SRK			267	95			0.1 U	0.1 U		24	1.1	54	1 U	50 U	180	0.05 U	1 U	1 U	190	190	200	180
1-Jun-84	SRK			93	24			0.1 U	0.1 U		0.9	0.5	7	3	70	850	0.05 U	1 U	5	40	80	40	30
12-Sep-84	SRK			228	73			0.1 U	0.1 U		0.4	0.9	3	5	60	230	0.05 U	1 U	1 U	130	160	90	110
6-Dec-84	SRK			283	96			0.1 U	0.1 U		0.7	0.6	1	1 U	80	300	0.05 U	1 U	1 U	170	190	100	110
8-Sep-93	USBR	60	6.9	200				2.2 U	2.2 U	0.63 U	1.4 U	1.4 U	13.3	4.1	56.3	231	0.21	7.6 U	7.6 U	164	160	14.6	126
17-Oct-95	PTI/ESA	38	6.7	267	110	215	114 L	0.02 U	0.02 U		0.52	0.52	10 U	10 U	145	228		0.22	0.47	218	216	125	123
23-Jan-96	ESA	NM	7.7	391	160	308	161 F	0.05 U	0.05 U		0.92 U	0.68 U	10 U	10 U	125	346		0.18	1.0	320	315	145	143
23-Apr-96	ESA	71	7.0	232	66	180	59 F	0.05 U	0.05 U		0.45	0.50	10 U	10 U	49	329		0.15 U	1.31	115	126	100	111
Dolores River Corridor Remediation Completed in October 1996.																							
24-Oct-96	ESA	39	7.6	233	78	171	114 F	0.02 U			0.33		10 U		112			0.12 U		175		124	
23-Jan-97	ESA	NM	8.3	299	110	226	147 F	0.03 U			0.70		10 U		141			0.5 U		269		178	
18-Apr-97	ESA	70	7.0	241	62	174	100 F	0.02 U			0.53		10 U		108			0.5 U		139		141	
30-Jul-97	ESA****	262	6.9	125	23	79	48 F	0.1 U			0.1 U		10 U		62			0.5 U		48		36	
Statistical Calculations - Undetects set to zero**																							
Mean		55		247	87	212	116	0	0	0	0.6	0.5	2.4	3.2	95	359	0	0.04	1.1	174	178	106	108
Standard Deviation		16		76	38	52	36	0	0	0	0.3	0.3	4.4	3.7	36	222	0	0.08	1.8	80	75	49	36
No. of Samples		5		10	9	6	6	10	7	1	10	7	10	7	10	7	3 ***	10	7	10	7	10	7

D = Dissolved CaCO3 = Calcium Carbonate Cd = Cadmium Hg = Mercury SO4 = Sulfate F = Field
T = Total recoverable Ag = Silver Cu = Copper Pb = Lead TDS = Total Dissolved Solids L = Lab
U = Not detected; value represents detection limit As = Arsenic Fe = Iron Mn = Manganese Zn = Zinc
J = Estimated NM = Not measured - Ice conditions in channel

* Also known as sampling stations DR51T and D-10.

** The St. Louis Ponds Water Treatment Plant began operating in April 1984. Prior data was excluded in calculations.

*** Excluded 1989-91 and 1993 data from Bureau of Reclamation report due to problems with data quality.

**** Preliminary flow rates collected from inactive USGS gaging station 4 miles southeast of Rico.

TABLE B-1.8

**Silver Swan Wetland Discharge
Water Quality Data Summary
(Sampling Station DR-6-SW)**

Date Sampled	Consultant	Flow (gpm)	pH (s.u.)	TDS (mg/L)	SO4 (mg/L)	Hardness (as CaCO3) (mg/L)	Alkalinity (as CaCO3) (mg/L)	Ag-D (ug/L)	Ag-T (ug/L)	Cd-D (ug/L)	Cd-T (ug/L)	Cu-D (ug/L)	Cu-T (ug/L)	Fe-D (ug/L)	Fe-T (ug/L)	Pb-D (ug/L)	Pb-T (ug/L)	Mn-D (ug/L)	Mn-T (ug/L)	Zn-D (ug/L)	Zn-T (ug/L)
17-Oct-95	PT/ESA	NM	7.2	211	54	180	134 L	0.02 U	0.43	1.38	2.43	10 U	10 U	52	1300	3.11	159	133	333	328	446
24-Jan-96	ESA/*NS																				
24-Apr-96	ESA	273	7.0	232	42	195	155 F	0.02 U	0.02 U	0.72	0.80	10 U	10 U	33	155	1.27	7.06	44	49	184	193
Dolores River Corridor Remediation Completed in October 1996.																					
23-Oct-96	ESA	31	7.3	233	55	189	134 F	0.02 U		0.87		10 U		51		0.35		183		224	
22-Jan-97	ESA/*NS																				
17-Apr-97	ESA	256	7.0	238	40	201	135 F	0.02 U		0.77		10 U		55		0.55		181		191	
31-Jul-97	ESA	480	6.3	169	26	122	97 F	0.1 U		0.50		10 U		126		0.70		209		127	
Statistical Calculations - Undetects set to zero																					
Mean		260		217	43	177	131	0.00	0.21	0.85	1.62	0	0	63	728	1.20	83	150	191	211	320
Standard Deviation		183		29	12	32	21	0.00	0.30	0.33	1.15	0	0	36	810	1.12	107	65	201	74	179
No. of Samples		4		5	5	5	5	5	2	5	2	5	2	5	2	5	2	5	2	5	2

D = Dissolved

T = Total recoverable

U = Not detected; value represents detection limit

J = Estimated

*NS = Not Sampled due to ice/zero flow conditions

CaCO3 = Calcium Carbonate

Ag = Silver

As = Arsenic

Cd = Cadmium

Cu = Copper

Fe = Iron

Hg = Mercury

Pb = Lead

Mn = Manganese Zn = Zinc

SO4 = Sulfate

TDS = Total Dissolved Solids

F = Field

L = Lab

TABLE B-1.9

Silver Swan Adit
Surface Water Quality Data Summary
 (Sampling Station DR-7-SW*)

Date Sampled	Consultant	Flow (gpm)	pH (n.u.)	TDS (mg/L)	SO4 (mg/L)	Hardness (as CaCO3) (mg/L)	Alkalinity (as CaCO3) (mg/L)	Ag-D (ug/L)	Ag-T (ug/L)	As-T (ug/L)	Cd-D (ug/L)	Cd-T (ug/L)	Cu-D (ug/L)	Cu-T (ug/L)	Fe-D (ug/L)	Fe-T (ug/L)	Hg-T (ug/L)	Pb-D (ug/L)	Pb-T (ug/L)	Mn-D (ug/L)	Mn-T (ug/L)	Zn-D (ug/L)	Zn-T (ug/L)	
30-Oct-80	Gibbs & Hill	22	7.5	884	188						10	10 U	10	10 U	50 U	2860	0.3 U	50 U	50 U	2050		3400	3400	
20-Nov-80	Gibbs & Hill	45	7.4	916	284						20	20	10 U	10	50 U	6600	0.3 U	50 U	50 U	2050		2400	2400	
17-Dec-80	Gibbs & Hill	45	7.2	900	245						10 U	10 U	10 U	10	3060	6900	0.3 U	50 U	50 U	2180		2300	2500	
21-Jan-81	Gibbs & Hill	31	7.2	924	318	868					10 U	10 U	10	10	1810	8000	0.3 U	50 U	50 U	2420		2800	2800	
23-Feb-81	Gibbs & Hill	36	7.4	940	320	830			5.7		10 U	10 U	10 U	10 U	3100	8400	0.3 U	50 U	50 U	2500		4200	4200	
23-Mar-81	Gibbs & Hill	45	6.9	952	324	855			0.1 U	1 U	4	4	5	3550	5200	0.05 U	1 U	1 U	2650		2800	3000		
22-Apr-81	Gibbs & Hill	67	6.6	748	172	676			0.1 U		2.2	2.2	1 U	1	2160	3640	0.05 U	1 U	1 U	1080		1300	1400	
11-May-81	Gibbs & Hill	54	7.0	928	274	755			0.1 U		1.2	1.2	1	1	3050	3660	0.05 U	6	6	1670		1800	1800	
21-May-81	Dames & Moore				327	788	555 L				10 U	10 U	10 U	10 U	5180	5200	0.3 U	50 U	10 U	1800	1800	1900	1900	
1-Jun-81	Gibbs & Hill	27	7.2	862	226	755			0.1 U		3.2	3.3	1 U	1 U	860	2110	0.05 U	1 U	1 U	1820		2400	2400	
24-Jun-81	Gibbs & Hill	27	7.3	793	169	768			0.1 U		1.8	1.8	16	26	50 U	3600	0.05 U	1 U	1 U	2250		2100	2600	
14-Jul-81	Gibbs & Hill	27	7.3	896	244	734			0.1 U		3.4	4.4	1 U	22	120	8700	0.05 U	1 U	1 U	2050		3200	3200	
12-Aug-81	Gibbs & Hill	18	7.1	1028	320	884			0.1 U		7.2	7.5	1 U	1 U	130	6700	0.05 U	1	4	2690		2400	2700	
11-Sep-81	Gibbs & Hill	22	6.9	1012	279	846			0.1 U		3.3	3.3	1	7	3050	7000	0.05 U	1 U	9	2770		2700	2700	
7-Oct-81	Gibbs & Hill	27	6.8	892	267	797			0.1 U		3	3	1	1	2140	5800	0.05 U	1 U	9	2060		2500	2600	
16-Jun-82	SRK	72	6.7	1146	353	955	588 L	0.05 U	0.07		8	8	26	27	50 U	380	0.01 U	1 U	1 U	1510	1610	2000	2000	
17-Mar-83	SRK	99	7.2	1160	304			0.1 U	0.1 U		1.6	1.1	11	11	50 U	220	0.05 U	1 U	3	480	510	1010	1010	
12-Jun-83	SRK	193	6.9	990	361			0.1 U	0.1 U		4	4.5	30	32	150	970	0.05 U	1	3	1750	2050	3700	3900	
22-Sep-83	SRK	144	6.8	1021	300			0.1 U	0.1 U		1.9	1.9	13	26	50 U	310	0.1	1 U	1 U	400	400	1400	1400	
15-Dec-83	SRK			1110	266			0.1 U	0.1 U		2	1.9	16	23	70	210	0.05 U	1 U	1 U	380	380	1200	1200	
12-Aug-91	USBR	0.0	5.7	942				4 U	4 U	30 U	1	0.8	5 U	5 U	4620	4650	0.1 U	30 U	30 U	1290	1240	780	765	
14-Jul-92	USBR	1.8	5.7	656				0.1	0.3	59	0.15	0.4	6	23	3107	3260	0.3	2	7	493	732	31	79	
15-Sep-92	USBR	51	6.8	930				10 U	10 U	10 U	5 U	5 U	25 U	25 U	8700	10300	0.03 U	3 U	7.4	1800	1800	910	980	
1-Jun-95	PTV/ESA	50	5.4	605		568	427 F	0.08			3	3 U	3 U	10 U	10 U	1600	1680	0.5 U	9.0	11.6	621	634	343	361
17-Oct-95	PTV/ESA	18	5.7	798	180	669	550 L	0.02 U	0.02 U		1.1	1.1	10 U	10 U	6270	7580		6.6	9.4	1340	1450	733	781	
24-Jan-96	ESA	13	6.1	854	190	724	480 F	0.05 U	0.05 U		0.98	1.2	10 U	10 U	8690	8630		7.6	11.3	1680	1660	903	888	
24-Apr-96	ESA	49	5.3	660	96	594	360 F	0.02 U	0.02 U		0.79	0.85	10 U	10 U	1890	1930		6.0	7.9	628	631	345	348	
Dolores River Corridor Remediation Completed in October 1996.																								
23-Oct-96	ESA	10.7	6.0	910	200	738	564 F	0.02 U			0.72		10 U		8370			5.6		1700		883		
22-Jan-97	ESA	NM	6.5	850	170	700	496 F	0.05			0.66		10 U		6210			1.2		1560		723		
17-Apr-97	ESA	NM	5.9	735	120	644	420 F	0.02 U			1.29		10 U		2590			6.6		890		501		
31-Jul-97	ESA	135	5.7	686	140	599	415 F	0.1 U			1.5		10 U		3120			4.2		963		567		
Statistical Calculations - Undetects set to zero																								
Mean		49		891	246	750	486	0.01	0.29	12	2.6	2.7	4.7	8.7	2696	4870	0.0	1.8	3.3	1598	1146	1749	1975	
Standard Deviation		45		139	74	103	78	0.03	1.24	26	4.0	4.1	8.1	10.9	2693	3175	0.1	2.9	4.2	720	612	1100	1118	
No. of Samples		27		30	27	21	10	16	21	5	31	27	31	27	31	27	24	31	27	31	13	31	27	

D = Dissolved

CaCO₃ = Calcium Carbonate

Cd = Cadmium

Hg = Mercury

SO₄ = Sulfate

F = Field

T = Total recoverable

Ag = Silver

Cu = Copper

Pb = Lead

TDS = Total Dissolved Solids

L = Lab

U = Not detected; value represents detection limit

As = Arsenic

Fe = Iron

Mn = Manganese

Zn = Zinc

J = Estimated

NM = Not measured - Ice conditions in channel/backwater

*Also known as sampling stations DR28T and D-09.

TABLE B-1.10
Santa Cruz Adit
Surface Water Quality Data Summary
(Sampling Station DR-8-SW*)

Date Sampled	Consultant	Flow (gpm)	pH (a.u.)	TDS (mg/L)	SO4 (mg/L)	Hardness as CaCO3 (mg/L)	Alkalinity (as CaCO3) (mg/L)	Ag-D (ug/L)	Ag-T (ug/L)	As-T (ug/L)	Cd-D (ug/L)	Cd-T (ug/L)	Cu-D (ug/L)	Cu-T (ug/L)	Fe-D (ug/L)	Fe-T (ug/L)	Hg-T (ug/L)	Pb-D (ug/L)	Pb-T (ug/L)	Mn-D (ug/L)	Mn-T (ug/L)	Zn-D (ug/L)	Zn-T (ug/L)
31-Oct-80	Gibbs & Hill	22	7.3	1164	295						30	30	20	60	50 U	2870	0.3 U	50 U	50 U	1560		5800	5800
20-Nov-80	Gibbs & Hill	22	6.4	1140	285						20	20	10	40	50 U	340	0.3 U	50 U	50 U	1520		1300	1400
17-Dec-80	Gibbs & Hill	22	6.6	1156	310	1024					20	20	10	20	50 U	360	0.3 U	50 U	50 U	1540		7500	7600
21-Jan-81	Gibbs & Hill	36	6.3	1040	345	1054					10 U	10 U	20	30	50 U	630	0.3 U	50 U	50 U	1410		6200	6200
23-Feb-81	Gibbs & Hill	36	6.7	1356	393	1090		0.6			10 U	10 U	10 U	10 U	50 U	530	0.3 U	50 U	50 U	1260		1100	1100
23-Mar-81	Gibbs & Hill	27	6.6	1184	395	1072		7			1 U	4	19	19	50 U	470	2.5	1 U	1 U	1280		1100	1100
23-Apr-81	Gibbs & Hill	36	6.4	1140	326	1009		0.1 U			3.5	3.5	12	14	50 U	610	0.05 U	1 U	1 U	1230		1100	1200
11-May-81	Gibbs & Hill	36	6.6	1212	426	1042		0.1 U			1.5	1.6	23	25	50 U	260	0.49	1 U	1 U	1250		1200	1400
21-May-81	Dames & Moore				444	1046	692 L			10 U	10	10	20	50	90	2170	0.3 U	50 U	10	1240	1260	1080	1080
1-Jun-81	Gibbs & Hill	13	6.3	1163	328	980		0.1 U			2	2	10	10	50 U	420	10	1 U	1 U	1060		1200	1200
22-Jun-81	Gibbs & Hill	13	6.3	1060	264	930		0.1 U			1.5	1.5	7	17	50 U	360	0.05 U	1 U	1 U	1160		1200	7400
14-Jul-81	Gibbs & Hill	27	6.7	1191	347	1009		0.1 U			3	3.2	15	22	50 U	350	0.05 U	1 U	1 U	1130		6200	6200
10-Aug-81	Gibbs & Hill		6.4	1302	342	1088		1.2			15	15	75	164	50 U	1640	0.05 U	37	37	1410		4200	4200
11-Sep-81	Gibbs & Hill	27	6.3	1253	370	1025		0.1 U			3	3	9	11	50 U	290	0.05 U	1 U	6	1400		9500	9500
8-Oct-81	Gibbs & Hill	22	6.4	1164	369	1042		0.1 U			3	3	7	7	50 U	260	0.16	1 U	1 U	1210		1600	1700
16-Jun-82	SRK	15	8.5	1182	498	951	442 L	0.08	0.14		27	41	310	310	50 U	2680	0.07	1 U	7	1570	1690	7000	8700
17-Mar-83	SRK		8.3	1210	548			0.1 U	0.1 U		97	105	290	1750	50 U	3750	0.05 U	1 U	22	3000	3300	11100	17200
12-Jun-83	SRK	4.5	7.8	979	375			0.1 U	0.1 U		7.2	7.1	115	151	110	980	0.05 U	2	5	800	850	5600	6100
22-Sep-83	SRK	0.58	7.6	1004	411			0.1 U	0.1 U		56	65	580	1040	50 U	2360	0.05 U	1 U	3	1700	1860	8800	9900
15-Dec-83	SRK			1090	453			0.1 U	0.1 U		57	66	230	1920	50 U	5370	0.05 U	1 U	10	2550	2700	9000	14800
1-Jun-95	PTI/ESA	50	6.2	1100		956	572 F	0.03			9	9	83	90	55	604	0.5 U	0.15	1.1	1290	1230	2990	2870
17-Oct-95	PTI/ESA	14	6.6	1050	280	914	692 L	0.02 U	0.02 U		2.7	2.4	14	15	51	268		0.23	1.4	203	212	1310	1340
22-Jan-96	ESA	7.1	6.7	998	270	933	640 F	0.05 U	0.05 U		2.3	2.3	16	16	48	198		0.74 U	1.3 J	164	166	1200	1210
25-Apr-96	ESA	49.4	6.0	1090	260	945	580 F	0.02 U	0.02 U		2.2	2.2	21	21	108	217	0.5 U	0.22	0.8	264	266	1220	1230
Dolores River Corridor Remediation Completed in October 1996.																							
23-Oct-96	ESA	8.13	6.5	1210	280	1020	690 F	0.02 U			1.96		14		59		0.2 U	0.18 U		203		1300	
22-Jan-97	ESA	14.7	7.7	1110	250	929	750 F	0.08			1.98		12		63			0.5 U		180		1160	
16-Apr-97	ESA	36	7.2	1060	300	930	645 F	0.03			2.17		17		49			0.5 U		396		1200	
30-Jul-97	ESA	27J	6.3	1080	280	858	555 F	0.1 U			3.5		21		36			0.5 U		357		1480	
Statistical Calculations - Undetects set to zero																							
Mean		24		1137	350	990	626	0.02	0.5	0	14	17	71	242	24	1166	0.57	1.4	4.4	1155	1353	3701	5018
Standard Deviation		13		91	77	60	90	0.03	1.7		22	27	131	535	36	1356	2.1	7.0	8.7	678	1062	3258	4562
No. of Samples		24		27	27	22	10	13	18	1	28	24	28	24	28	24	23	28	24	28	10	28	24

D = Dissolved
T = Total recoverable
U = Not detected; value represents detection limit
J = Estimated

CaCO3 = Calcium Carbonate
Ag = Silver
As = Arsenic

Cd = Cadmium
Cu = Copper
Fe = Iron

Hg = Mercury
Pb = Lead
Mn = Manganese

SO4 = Sulfate
TDS = Total Dissolved Solids
Zn = Zinc

F = Field
L = Lab

* Also known as sampling stations D-08, Santa Cruz Adit, and Santa Cruz A.

TABLE B-1.11

**Santa Cruz Wetland East Drainage
Water Quality Data Summary
(Sampling Station DR-9-SW)**

Date Sampled	Consultant	Flow (gpm)	pH (s.u.)	TDS (mg/L)	SO4 (mg/L)	Hardness (as CaCO3) (mg/L)	Alkalinity (as CaCO3) (mg/L)	Ag-D (ug/L)	Ag-T (ug/L)	As-T (ug/L)	Cd-D (ug/L)	Cd-T (ug/L)	Cu-D (ug/L)	Cu-T (ug/L)	Fe-D (ug/L)	Fe-T (ug/L)	Hg-T (ug/L)	Pb-D (ug/L)	Pb-T (ug/L)	Mn-D (ug/L)	Mn-T (ug/L)	Zn-D (ug/L)	Zn-T (ug/L)
1-Jun-95	PTI/ESA	100	7.3	542	200	452	242 F	0.03		1 U	4		10 U		20 U					207		702	
17-Oct-95	PTI/ESA	25		616	240	505	275 L	0.02 U	0.02 U		1.04	1.01	10 U	10 U	105	182		0.10	0.31	505	508	199	192
24-Jan-96	ESA	NM	7.1	700	240	593	322 F	0.05 U	0.05 U		1.3	2.06	10 U	12	433	1620		0.18 U	4.82 J	730	1020	258	317
25-Apr-96	ESA	197	7.0	526	180	434	240 F	0.02 U	0.02 U		1.95	1.92	10 U	10 U	98	159	0.5 U	0.05 U	0.28	202	206	592	612
Dolores River Corridor Remediation Completed in October 1996.																							
23-Oct-96	ESA	67	6.9	576	200	433	264 F	0.02 U			0.61		10 U		247			0.11 U		854		168	
22-Jan-97	ESA	NM	7.9	524	160	421	276 F	0.02 U			0.66		10 U		372			0.5 U		1110		229	
17-Apr-97	ESA	256	7.3	357	95	310	175 F	0.02 U			0.68		10 U		147			0.5 U		621		248	
30-Jul-97	ESA/NS																						
Statistical Calculations - Undetects set to zero																							
Mean		129		549	188	450	256	0.00	0	0	1.5	1.7	0	4	200	654	0	0.02	1.8	604	578	342	374
Standard Deviation		95		105	50	86	45	0.01	0	0	1.2	0.6	0	7	157	837	0	0.04	2.6	333	411	213	216
No. of Samples		5		7	7	7	7	7	3	1	7	3	7	3	7	3	1	6	3	7	3	7	3

D = Dissolved

T = Total recoverable

U = Not detected; value represents detection limit

J = Estimated

*NS=Not sampled due to overflow from the Dolores River.

CaCO3 = Calcium Carbonate

Ag = Silver

As = Arsenic

NM = Not measured - Ice conditions in channel

Cd = Cadmium

Cu = Copper

Fe = Iron

Hg = Mercury

Pb = Lead

Mn = Manganese

SO4 = Sulfate

TDS = Total Dissolved Solids

Zn = Zinc

F = Field

L = Lab

TABLE B-1.12
Santa Cruz Wetland West Drainage
Water Quality Data Summary
(Sampling Station DR-10-SW)

Date Sampled	Consultant	Flow (gpm)	pH (s.u.)	TDS (mg/L)	SO ₄ (mg/L)	Hardness (as CaCO ₃) (mg/L)	Alkalinity (as CaCO ₃) (mg/L)	Ag-D	Ag-T	As-T	Cd-D	Cd-T	Cu-D	Cu-T	Fe-D	Fe-T	Hg-T	Pb-D	Pb-T	Mn-D	Mn-T	Zn-D	Zn-T
17-Oct-95	PTI/ESA	0.4 U	6.7	980	460	795	378 L	0.11	0.03		2.80	2.61	24	50	161	684		0.14	1.76	291	367	520	554
24-Jan-96	ESA/**NS																						
25-Apr-96	ESA	99	5.8	726	290	573	260 F	0.02 U	0.05 U		4.12	4.29	56	174	74	1460	0.5 U	0.06 U	0.29	899	912	1140	1220
Dolores River Corridor Remediation Completed in October 1996																							
23-Oct-96	ESA/**NS																						
22-Jan-97	ESA/**NS																						
17-Apr-97	ESA	NM	7.3	1080	320	903	530 F	0.02 U			1.52		10		52			0.5 U		194		775	
31-Jul-97	ESA	<4	7.0	983	290	760	450 F	0.1 U			1.70		10 U		101			0.5 U		366		626	
Statistical Calculations - Undetects set to zero																							
Mean		33		942	340	758	405	0.03	0.02		2.54	3.45	23	112	97	1072	0	0.04	1.03	438	640	765	887
Standard Deviation		57		151	81	137	115	0.06	0.02		1.20	1.19	24	88	47	549	0	0.07	1.04	316	385	271	471
No. of Samples		2		4	4	4	4	4	2	0	4	2	4	2	4	2	1	4	2	4	2	4	2

D = Dissolved

T = Total recoverable

U = Not detected; value represents detection limit

J = Estimated

*NS = Not Sampled due to ice/zero flow conditions

CaCO₃ = Calcium Carbonate

Ag = Silver

As = Arsenic

NM = Not measured - Ice conditions in channel/Non-channelized

Cd = Cadmium

Cu = Copper

Fe = Iron

Hg = Mercury

Pb = Lead

Mn = Manganese

Zn = Zinc

F = Field

L = Lab

TABLE B-1.13

**Sulfer Creek above Discharge to Silver Swan Wetland
Water Quality Data Summary
(Sampling Station DR-15-SW)**

Date Sampled	Consultant	Flow (gpm)	pH (s.u.)	TDS (mg/L)	SO4 (mg/L)	Hardness (as CaCO3) (mg/L)	Alkalinity (as CaCO3) (mg/L)	Ag-D (ug/L)	Ag-T (ug/L)	Cd-D (ug/L)	Cd-T (ug/L)	CN (mg/L)	Cu-D (ug/L)	Cu-T (ug/L)	Fe-D (ug/L)	Fe-T (ug/L)	Pb-D (ug/L)	Pb-T (ug/L)	Mn-D (ug/L)	Mn-T (ug/L)	Zn-D (ug/L)	Zn-T (ug/L)
18-Oct-95	PTI/ESA	26.9	7.8	131	25	101	80 L	0.03	0.02 U	1.18	1.13		10 U	10 U	20 U	20 U	1.51	1.70	10 U	10 U	170	162
25-Jan-96	ESA/*NS																					
24-Apr-96	ESA	292	8.0	87	14	67.2	44 F	0.02 U	0.02 U	0.76	0.99		10 U	10 U	20 U	101	1.36	8.61	5 U	9	132	147
Dolores River Corridor Remediation Completed in October 1996.																						
23-Oct-96	ESA/*NS																					
22-Jan-97	ESA/*NS																					
17-Apr-97	ESA**	75.6	8.1	124	18	80.1	52 F	0.02 U		0.60			10 U		20 U		0.88		5 U		103	
31-Jul-97	ESA**	296	7.7	116	15	65.3	45 F	0.1 U		0.5			10 U		20 U		0.80		5 U		76	
Statistical Calculations - Undetects set to zero																						
Mean		173		115	18	78	55	0.01	0	0.76	1.06		0	0	0	51	1.14	5.16	0	5	120	155
Standard Deviation		142		19	5	16	17	0.02	0	0	0		0	0	0	71	0.35	4.89	0	6	40	11
No. of Samples		4		4	4	4	4	4	2	4	2	0	4	2	4	2	4	2	4	2	4	2

D = Dissolved

CaCO3 = Calcium Carbonate

Cd = Cadmium

Fe = Iron

SO4 = Sulfate

F = Field

T = Total recoverable

Ag = Silver

Cu = Copper

Pb = Lead

TDS = Total Dissolved Solids

L = Lab

U = Not detected; value represents detection limit

As = Arsenic

CN = Cyanide

Mn = Manganese

Zn = Zinc

J = Estimated

*NS = Not Sampled

**Sampling station DR-15a-SW was relocated 150 yards downstream from station DR-15-SW after construction.

TABLE B-1.14
Rico Boy Adit
Surface Water Quality Data Summary
(Sampling Station DR-16-SW*)

Date Sampled	Constituent	Flow (gpm)	pH (a.u.)	TDS (mg/L)	SO4 (mg/L)	Hardness as CaCO3 (mg/L)	Alkalinity (as CaCO3) (mg/L)	Ag-D (ug/L)	Ag-T (ug/L)	As-T (ug/L)	Cd-D (ug/L)	Cd-T (ug/L)	Cu-D (ug/L)	Cu-T (ug/L)	Fe-D (ug/L)	Fe-T (ug/L)	Hg-T (ug/L)	Pb-D (ug/L)	Pb-T (ug/L)	Mn-D (ug/L)	Mn-T (ug/L)	Zn-D (ug/L)	Zn-T (ug/L)
15-Sep-92	USBR**	9.0	7.0	1120				10 U	10 U	10 U	5 U	5 U	25 U	27	100 U	350	0.03 U	3 U	3 U	260	260	1100	1300
18-Oct-95	PTI/ESA	2.5	7.0	1160	330	982	676 L	0.02 U	0.03		21.1	21.4	10 U	11	60	3630		0.18	14.1	1030	1020	8550	9820
22-Jan-96	ESA	2.0	8.1	1180	370	1040	708 F	0.05 U	0.05 U		24.0	23.7	10 U	10 U	60	272		0.12 U	0.61 U	945	930	9860	9730
24-Apr-96	ESA	1.3	7.5	1160	320	946	590 F	0.02 U	0.02 U		17.4	17.1	10 U	10 U	46	136	0.5 U	0.18 U	0.35	918	903	9240	9120
Dolores River Corridor Remediation Completed in October 1996.																							
23-Oct-96	ESA	4.0	7.3	1350	390	1020	685 F	0.02 U			15.0		10 U		63			2.38		811		9080	
22-Jan-97	ESA	3.5	8.3	1200	360	1020	675 F	0.07			17.0		10 U		72			0.6		888		8740	
16-Apr-97	ESA	6.7	7.4	967	250	1010	460 F	0.02 U			13.6		10 U		62			0.5 U		1270		7620	
30-Jul-97	ESA	4.5	6.3	840	200	1030	695 F	0.1 U			15.9		10 U		52			0.5 U		1930		7690	
Statistical Calculations - Undetects set to zero																							
Mean		3.5		1122	317	1007	641	0.01	0.01		17.7	20.7	0	4	59	1346	0	0.45	4.8	1113	951	8683	9557
Standard Deviation		1.8		167	69	32	89	0.03	0.02		3.7	3.4	0	6	8	1979	0	0.88	8.0	389	61	815	381
No. of Samples		7		7	7	7	7	7	3		7	3	7	3	7	3	1	7	3	7	3	7	3

D = Dissolved

T = Total recoverable

U = Not detected; value represents detection limit

J = Estimated

CaCO3 = Calcium Carbonate

Ag = Silver

As = Arsenic

Cd = Cadmium

Cu = Copper

Fe = Iron

Hg = Mercury

Pb = Lead

Mn = Manganese

SO4 = Sulfate

TDS = Total Dissolved Solids

Zn = Zinc

F = Field

L = Lab

* Also known as sampling station DRDOL48T.

** Sample location may have been confused with Santa Cruz Adit because Zinc values do not reflect more recent data. September 1992 data were not used in the statistical calculations at this station.

TABLE B-1.15
Dolores River Downstream of Santa Cruz Site and Upstream of Silver Swan Site
Water Quality Data Summary
(Sampling Station DR-18-SW)

Date Sampled	Consultant	Flow (gpm)	pH (s.u.)	TDS (mg/L)	SO4 (mg/L)	Hardness (as CaCO3) (mg/L)	Alkalinity (as CaCO3) (mg/L)	Ag-D (ug/L)	Ag-T (ug/L)	Cd-D (ug/L)	Cd-T (ug/L)	CN (mg/L)	Cu-D (ug/L)	Cu-T (ug/L)	Fe-D (ug/L)	Fe-T (ug/L)	Pb-D (ug/L)	Pb-T (ug/L)	Mn-D (ug/L)	Mn-T (ug/L)	Zn-D (ug/L)	Zn-T (ug/L)
25-Jan-96	ESA	NM	7.4	380	150	293	136 F	0.05 U	0.05 U	0.74	0.68		10 U	10 U	154	396	0.19 U	1.03 J	300	307	140	146
23-Apr-96	ESA	27064	6.8	235	72	190	88 F	0.05 U	0.05 U	0.47	0.50		10 U	10 U	81	304	0.12 U	1.09	140	140	120	123
Dolores River Corridor Remediation Completed in October 1996.																						
24-Oct-96	ESA	15777	7.6	234	90	172	120 F	0.02 U		0.52			10 U		107		0.12 U		180		123	
23-Jan-97	ESA	NM	9.0	293	110	212	128 F	0.02 U		0.67			10 U		145		0.5 U		257		164	
17-Apr-97	ESA	29982	6.9	182	56	160	88 F	0.02 U		0.52			10 U		122		0.5 U		127		134	
30-Jul-97	ESA*	117593	7.3	121	23	74	46 F	0.1 U		0.1 U			10 U		68		0.5 U		52		41	
Statistical Calculations - Undetects set to zero																						
Mean		47604		241	84	184	101	0	0	0.49	0.6		0	0	113	350	0	1.06	176	224	120	135
Standard Deviation		47060		89	44	71	34	0	0	0.26	0.1		0	0	34	65	0	0.04	91	118	42	16
No. of Samples		4		6	6	6	6	6	2	6	2		6	2	6	2	6	2	6	2	6	2

D = Dissolved

CaCO3 = Calcium Carbonate

Cd = Cadmium

Fe = Iron

SO4 = Sulfate

F = Field

T = Total recoverable

Ag = Silver

Cu = Copper

Pb = Lead

TDS = Total Dissolved Solids

L = Lab

U = Not detected; value represents detection limit

As = Arsenic

CN = Cyanide

Mn = Manganese

Zn = Zinc

J = Estimated

NM = Not measured - Ice conditions in channel

* Preliminary flow rates collected from inactive USGS gaging station 4 miles southeast of Rico.

**B2 Post-VCUP Surface Water
Sampling Field Parameters**

TABLE B-2 RICO POST-VCUP SURFACE WATER SAMPLING FIELD PARAMETERS - 1996 and 1997

SAMPLING STATION	DATE SAMPLED	pH	TEMP (C°)	SPECIFIC CONDUCTANCE (μ S/cm)	DISSOLVED OXYGEN (mg/L)	Fe(II) (mg/L)	Fe(tot) (mg/L)	ALKALINITY (mg/L) as CaCO ₃	FLOW (cfs)
SVS-5	10-22-96	8.0	0.0	112	10.4	0.02	0.41	50	1.64
SVS-5	4-16-97	8.4	1.8	119	9.8	0.01	0.84	191	2.33
SVS-5	7-29-97	7.6	8.0	112	8.6	0.18	1.39	69	5.68
SVS-8	10-22-96	8.0	2.7	183	7.0	0.07	0.54	101	2.32
SVS-8	1-21-97	8.9	0.0	190	7.7	0.00	0.00	115	iced up
SVS-8	4-16-97	7.2	5.0	196	9.6	0.07	0.08	86	2.27
SVS-8	7-29-97	7.5	10.1	169	8.4	0.02	1.16	70	6.05
SVS-11	10-22-96	7.6	8.3	721	3.1	2.6	7.40	98	non-channelized
SVS-11	1-21-97	8.3	0.5	390	7.0	0.10	0.45	110	iced up
SVS-11	4-16-97	7.6	9.6	810	8.0	1.92	3.82	127	non-channelized
SVS-11	7-29-97	7.3	16.0	1055	4.7	3.02	4.41	133	0.11 *
SVS-12	10-22-96	7.1	6.0	501	3.1	5.90	6.80	116	0.10
SVS-12	1-21-97	7.6	3.2	493	6.1	9.00	10.3	130	0.12
SVS-12	4-16-97	6.7	10.5	807	5.9	10.8	11.8	150	0.11
SVS-12	7-29-97	6.5	8.5	822	6.5	7.00	12.6	138	0.13
DR-1-SW	10-23-96	6.5	6.8	270	1.9	5.70	6.60	97	0.38
DR-1-SW	1-22-97	7.0	1.8	283	9.4	4.60	5.00	177	0.25
DR-1-SW	4-17-97	6.2	3.1	385	8.2	5.20	13.5	125	0.14
DR-1-SW	7-30-97	7.2	10.5	99	8.5	0.15	1.24	44	77.6
DR-2-SW	10-24-96	7.5	1.4	184	10.7	0.03	0.09	121	40.7

TABLE B-2 RICO POST-VCUP SURFACE WATER SAMPLING FIELD PARAMETERS - 1996 and 1997

SAMPLING STATION	DATE SAMPLED	pH	TEMP (C°)	SPECIFIC CONDUCTANCE (μ S/cm)	DISSOLVED OXYGEN (mg/L)	Fe(II) (mg/L)	Fe(tot) (mg/L)	ALKALINITY (mg/L) as CaCO ₃	FLOW (cfs)
DR-2-SW	1-23-97	8.2	0.3	219	10.8	0.05	0.09	112	iced up
DR-2-SW	4-18-97	7.0	5.7	195	8.8	0.02	0.14	122	73.7
DR-2-SW	7-30-97	7.3	10.0	111	8.4	0.02	0.60	47	262**
DR-4-SW	10-24-96	7.6	0.0	183	9.4	0.19	0.21	114	38.8
DR-4-SW	1-23-97	8.3	1.1	235	9.9	0.12	0.17	147	iced up
DR-4-SW	4-18-97	7.0	3.1	191	9.7	0.08	0.19	100	70.3
DR-4-SW	7-30-97	6.9	10.6	117	8.6	0.03	1.73	48	262**
DR-6-SW	10-23-96	7.3	4.1	226	4.5	0.06	0.09	134	0.07
DR-6-SW	4-17-97	7.0	11.9	262	8.6	0.03	0.16	135	0.57
DR-6-SW	7-31-97	6.3	12.8	203	7.5	0.13	0.40	97	1.07
DR-7-SW	10-23-96	6.0	11.2	868	3.3	8.60	9.20	564	0.02
DR-7-SW	1-22-97	6.5	7.5	731	5.5	4.00	6.80	496	backwater
DR-7-SW	4-17-97	5.9	11.4	724	3.1	2.30	2.50	420	backwater
DR-7-SW	7-31-97	5.7	10.9	702	4.3	3.09	3.21	415	0.30
DR-8-SW	10-23-96	6.5	17.0	1178	3.5	0.01	0.14	690	0.02
DR-8-SW	1-22-97	7.7	6.3	929	6.8	0.02	0.14	750	0.03
DR-8-SW	4-16-97	7.2	15.0	1131	4.5	0.01	0.20	645	0.06
DR-8-SW	7-30-97	6.3	15.8	1103	4.2	0.00	0.09	555	0.06*
DR-9-SW	10-23-96	6.9	7.7	480	2.3	0.25	0.40	264	0.15

TABLE B-2 RICO POST-VCUP SURFACE WATER SAMPLING FIELD PARAMETERS - 1996 and 1997

SAMPLING STATION	DATE SAMPLED	pH	TEMP (C°)	SPECIFIC CONDUCTANCE (μ S/cm)	DISSOLVED OXYGEN (mg/L)	Fe(II) (mg/L)	Fe(tot) (mg/L)	ALKALINITY (mg/L) as CaCO ₃	FLOW (cfs)
DR-9-SW	1-22-97	7.9	1.8	397	8.1	0.30	0.48	276	ice/snow
DR-9-SW	4-17-97	7.3	6.8	329	8.8	0.09	0.33	175	0.57
DR-10-SW	4-17-97	7.3	12.3	1002	11.3	0.03	0.04	530	0.01*
DR-10-SW	7-31-97	7.0	14.2	947	5.8	0.00	0.12	450	<0.01
DR-15A-SW	4-17-97	8.1	6.7	97	9.6	0.05	0.00	52	0.003
DR-15A-SW	7-31-97	7.7	11.4	100	7.7	0.00	0.00	45	0.66
DR-16-SW	10-23-96	7.3	13.5	1198	5.5	0.05	0.14	685	0.01
DR-16-SW	1-22-97	8.3	3.5	439	8.4	0.10	0.10	675	0.01
DR-16-SW	4-16-97	7.4	11.8	1060	6.6	0.04	0.23	460	0.02
DR-16-SW	7-30-97	6.3	12.9	695	6.0	0.21	0.80	695	0.01
DR-18-SW	10-24-96	7.6	0.1	168	10.1	0.14	0.15	120	35.2
DR-18-SW	1-23-97	9.0	0.4	219	10.7	0.16	0.16	128	iced up
DR-18-SW	4-18-97	6.9	5.9	200	9.1	0.07	0.19	88	66.8
DR-18-SW	7-30-97	7.3	10.3	103	8.1	0.01	1.30	46	262**

* Estimated flow rates

** Preliminary flow rates collected from inactive USGS gaging station 4 miles ~~southeast~~ *downstream* of Rico

APPENDIX C

FIELD RECORDS

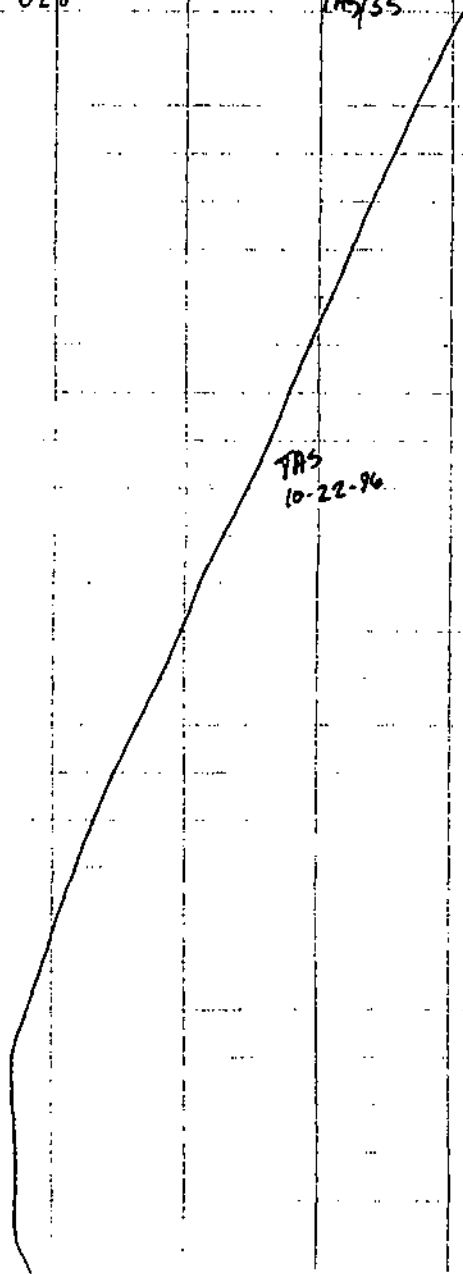
- C-1 Field Logbook Notes**
- C-2 Surface Water Sampling
Forms**
- C-3 Discharge Measurement
Procedures and Calculation
Sheets**

C1 Field Logbook Notes

001-028

TAS/SS

10-22-96

TAS
10-22-96

10-22-96

TAS/SS

001-29

SURFACE WATER MONITORING @ RICO PROJECT (POST-CONSTRUCTION)

CREW: TODD SULLIVAN (ESA)
STEVE STORY (ESA)

WEATHER: SNOWED ~ 48 hours ago.
about 3-6" on ground, Hard freeze
past 2 nites, 5°F @ 0900 AM.

Meters used for Water Quality Parameters
are listed on Page 001-000.

Specific Conductance Readings are
temp. compensated to 25°C.

PH readings are temp. compensated
to 25°C.

D.O. Readings are with elevation
setting @ sea level. Readings will
be adjusted to proper elevation back
in office.

001-030

TAS/ S.S

10/22/96

0942 PH Calibration

PH 7 \rightarrow 7.03 @ 16°CPH 4 \rightarrow 4.00 @ 15.9°C

SVS-5, slushy ice in channel - broke free

10:26 pH = 8.04 @ 0.0°C

EC = 112 μ S/cm @ 0.0°C

D.O. = 14.8 mg/L @ 0.0°C

Fe(II) = .02 mg/L

Fe(tot) = .41 mg/L

Alk = 50 mg/L

Took discharge measurement

1201 Collected samples # 123 & 124

SVS-8 no ice in channel

1:40 pH = 8.04 @ 2.7°C

EC = 183.7 μ S/cm @ 3.3°C

D.O. = 9.8 mg/L @ 4.0°C

Fe(II) = ~~2.04~~ mg/L = .07 mg/LFe(tot) = ~~2.6~~ mg/L = .54 mg/LAlk = 101 mg/L as CaCO_3

2:15 Collected samples # 125 & 126

TMS/SES

10/22/96

001-031

SVS-11 reddish orange sediment

3:00 channel is not well-contained ~ 2" depth

pH = 7.61 @ 8.3°C

EC = 721 μ S/cm @ 8.2°C

D.O. = 4.4 mg/L @ 10°C

Fe(II) = 2.6 mg/L

Fe(tot) = 7.40 mg/L

Alk = 98 mg/L

3:05 Collected samples # 127 & 128

3:30 Fluor reading: 0.22 f4

SVS-12 Channel is relatively clean

with very little Fe deposits. There are 2 seeps feeding one channel. Sampled the south seep about 5 ft from origin.

pH = 7.11 @ 6.0°C

EC = 501 μ S/cm @ 6.3°C

D.O. = 4.4 mg/L

Fe(II) = 5.90 mg/L

Fe(tot) = 6.80 mg/L

Alk = 116 mg/L as CaCO_3

4:25 Collected Sample & Duplicate

including CN & PCE

Samples: 129, 130, 131, 132, 133, 134

Dupes: 135, 136, 137, 138, 139, 140

001-032

10/23/96 THS/SES

SW MONITORING

Weather: Clear, 15°F, patches
of snow in area

DR7SW - Fe staining in new channel

0900

pH = 5.95 @ 11.2°C

EC = 868 μ S/cm @ 10.1°C

DO = 4.6 mg/L @ 11.0°C

Fe(II) = 8.6 mg/L

Fe(tot) = 9.2 mg/L

ALK = 564 mg/L as CaCO_3

0915

Collected Samples # 141 & 142

Discharge Measurement (Volumetric)
measured @ culvert outfall.

1015

1 gal / 5 sec

1 gal / 7 sec

1 gal / 7 sec

approx. 10% of flow was not measured

10/23/96

THS/SES

001-033

DR-G-SW

1030 pH = 7.32 @ 4.1°C

EC = 226 μ S/cm @ 4.0°C

DO = 6.3 mg/L @ 4.0°C

Fe(II) = .06 mg/L

Fe(tot) = .09 mg/L

ALK = 134 mg/L as CaCO_3

1040 Collected Samples # 143 & 144

Discharge Measurement: Floating method

dist	depth	Time for 1 ft in Sec (ave)	
0.0	0.0	0, 0, 0 vel	0.0 ft/s
0.1	.17	0, 0, 0 vel	0.0 ft/s
0.2	.17	11.6 sec ave	0.09 ft/s
0.3	.14	0, 0, 0 vel	0.0 ft/s
0.4	.14	4.6 sec	0.22 ft/s
0.5	.20	2.9 sec	0.34 ft/s
0.6	.20	3.0 sec	0.33 ft/s
0.7	.20	2.4 sec	0.42 ft/s
0.8	.20	2.5 sec	0.40 ft/s
0.9	.20	1.9 sec	0.53 ft/s
1.0	.19	2.3 sec	0.43 ft/s
1.2	.16	2.6 sec	0.38 ft/s
1.3	.17	15.0 sec	0.20 ft/s
1.4	.15	0 rel	0.0 ft/s

001-034

10/23/96

TAS/SES

DR-6-SW

Discharge

dist	depth	vel	
1.5	.08	0 vel	0 ft/s
1.6	.03	0 vel	0 ft/s
1.7	0.0	0 vel	0 ft/s

1130

DR-10-SW Frozen, Even if this drainage was thawed zero flow would make it to the river due to the low water level.

1145

DR-9-SW

pH = 6.93 @ 7.7°C

EC = 480 μ S/cm @ 6.8°C

DO = 3.2 mg/L @ 7.0°C

Fe(II) = .25 mg/L

Fe(tot) = .40 mg/L

Alk = 264 mg/L as CaCO_3

1150

Collected Samples # 145 & 146

Discharge Measurement by floating method

10/23/96

TAS/SES

001-035

DR-9-SW discharge Measurement

dist	depth	time to float / ft ave	vel. (ft/s)
0.0	0.0	0 veloc.	0.0
0.2	0.04	3.7 sec	.27
0.4	.10	3.2 "	.31
0.6	.17	3.0 "	.33
0.8	.22	2.7 "	.37
1.0	.31	3.1 "	.32
1.2	.34	2.7	.37
1.4	.35	2.8	.36
1.6	.30	3.1	.32
1.8	.22	2.7	.37
2.0	.11	2.5	.40
2.2	.05	2.4	.42
2.4	.02	3.0	.33
2.6	0.0	0 veloc.	

001-030

10/23/96

TAS/SES

DR-16-SW Rico Bay Adit

rust colored sediment in channel w/
abundant algae

pH = 7.26 @ 13.5°C

EC = 1198 μ S/cm @ 12.9

DO = 7.6 mg/L @ 13.0°C

Fe(II) = .05 mg/L

Fe(tot) = .14 mg/L

Alk = 685 mg/L CaCO_3

2:00 Collected Samples & Blanks

Blanks # 00147 & 00148

Sample # 00149 & 00150

Discharge Measurement

3:24 Filled 1 gallon in 15 seconds 3-times

L₂ discharge was collected at
18" outfall. 4 GPM

10/23/96

TAS/SES

001-032

DR-8-SW Santa Cruz Adit

2:40 Little staining (Fe) on new channel rocks
Abundant algae. Sampled @ door

pH = 6.50 @ 17.0°C

EC = 1178 μ S/cm @ 15.4°C

DO = 4.9 mg/L @ 16.5°C

Fe(II) = .01 mg/L

Fe(tot) = .14 mg/L

Alk = 690 mg/L as CaCO_3 / incl Hg

2:45 Collected Samples # 00151 & 00152

Discharge Measurement: volumetrically

3:10 9/10 gallon in 7.2 sec

9/10 gallon in 6.6 sec

9/10 gallon in 6.3 sec

9/10 gallon in 6.5 sec

001-038

10/23/96 TMS/SES

3:40 DR-1-SW Columbia Tailings seep
into Dolores R. East Channel

pH = 6.49 @ 6.8°C

EC = 270 μ S/cm @ 7.3°C

DO = 2.7 mg/L @ 7.0°C

Fe(II) = 5.7 mg/L

Fe(tot) = 6.6 mg/L

ALK = 97 mg/L as CaCO_3

4:00 Discharge Measurement

3:50 Collected Sample # 00153 & 00154

Cyanide 00155

Dist	depth	Time to float / ft (ave)	Vel. ft/s
0.0	0.0	0 velocity	0.0
0.2	0.00	0 velocity	0.0
0.4	0.26	1.8 sec	.56
0.6	0.28	1.5 sec	.66
0.8	0.34	1.4 sec	.71
1.0	0.35	1.4 sec	.71
1.2	0.18	1.7 sec	.59
1.4	0.32	1.4 sec	.71
1.6	0.23	1.7 sec	.59
1.8	0.25	2.2 sec	.45
2.0	0.23	1.8 sec	.56
2.2	0.04	2.1 sec	.48

10/23/96

TMS/SES

001-039

DR-1-SW (cont)

dist	depth	Time to float / ft	Vel (ft/s)
2.4	.17	2.1 sec	.48
2.6	.21	2.5 sec	.40
2.8	.15	4.2 sec	.24
3.0	.05	4.3 sec	.23
3.2	0.0	0 velocity	0.0
3.4	.15	4.6 sec	.22
3.6	.13	4.7 sec	.21
3.8	.10	5.4 sec	.19
4.0	0.0	0 velocity	0.0

~~DR-18-SW~~

TMS

10/23/96

001-040

10/24/96 TMS/SES

SW MONITORING

WEATHER: Calm 0°F

DR-4-SW

minor ice
or snow

no ice on banks

0330

pH = 7.59 @ 0.0°C

EC = 183 μ S/cm @ 0.2°C

DO = 1.3 mg/L @ 0.0°C

Fe(II) = 0.19

Fe(tot) = 0.21

Alk = 114 mg/L as CaCO_3

0900 Collected Samples # 156 & 157

Measured Discharge

DR-18-SW

no ice/snow

1000

pH = 7.53 @ 0.1°C

EC = 168 μ S/cm @ 0.2°C

DO = 1.4 mg/L @ 0°C

Fe(II) = 0.14

Fe(tot) = 0.15

Alk = 120 mg/L

1015

Collected Samples 158 & 159

1023

Measured Discharge

10/24/96

TMS/SES

001-041

DR-2-SW

no ice or snow

1100

pH = 7.51 @ 1.4°C

EC = 184 μ S/cm @ 2.0°C

DO = 14.8 mg/L @ 2°C

Fe(II) = 0.03 mg/L

Fe(tot) = 0.09 mg/L

Alk = 121 mg/L as CaCO_3

1115

Collected Samples # 160 & 161

1123

Measured Discharge

TMS

10/24/96

001-042

TAS/SES

1-21-97

SURFACE WATER SAMPLING POST VCUP MONITORING

CREW: TODD SULLIVAN (ESA)
STEVE STORY (ESA)

WEATHER: Snowing lightly ~ 25°F
about 1.5 ft of fresh snow on
ground

0945 SVS-5 Silver Crk near mill
Zero flow - ice with 1.5 ft of
snow cover.

1045 SVS-12 Argentine Seep
low flow - Fe Oxide on rocks
pH = 7.58 @ 3.2°C
EC = 493 μ S/cm @ 3.0°C
DO = 8.6 mg/L Calibration problems
ALK = 130 mg/L
Fe(II) = 9.0 mg/L
Fe(tot) = 10.3 mg/L
Flume Reading is 0.25
Tag # 162 & 163

TAS/SES

1-21-97

001-043

SVS-11 Argentine Seep flow @
confluence w/ Silver Creek
moderate flow - partially covered w/ snow
1:45 pH = 8.33 @ 0.05
EC = 390 μ S/cm
DO = 9.8 mg/L
Fe(II) = .10
Fe(tot) = .45
ALK = 110 mg/L
Tag # 164 & 165

SVS-8 Silver Creek Below Culvert
2:15 moderate flow - snow on banks
pH = 8.85 @ 6.00°C
EC = 190 μ S/cm
DO = 10.9 mg/L
ALK = 115 mg/L
Fe(II) = 0.00 mg/L
Fe(tot) = 0.00 mg/L
Flume Reading is 0.25
Tag # 167 & 166
Tox, etc. Diss. metals

001-044

TAS/SES

1-22-97

WEATHER: ~ 30°F - no snow
past 12 hrs. 2 ft on ground

Rice Bay adit DR-16-SW

0918 arrived at site - collected
samples @ culvert outfall

Measured Discharge Volumetrically
at culvert outfall.

1.9 Gallons in 33 sec

2.0 Gallons in 34 sec

2.0 Gallons in 34 sec

pH = 8.31 @ 3.5°C

EC = 439 μ S/cm @ 4.0°C

DO = 11.7 mg/L @ 5.0°C

ALK = 675 mg/L as CaCO_3

Fe(II) = .10 mg/L

Fe(tot) = .10 mg/L

Tag # 00168 & 00169

T.S. 1-22-97



TAS/SES

1-22-97 001-045

DR-8-SW

Santa Cruz Adit

0940 pH = 7.67 @ 6.3°C

EC = 929 μ S/cm @ 6.0°C

DO = 9.5 @ 4.0°C

ALK = 750 mg/L as CaCO_3

Fe(II) = .02 mg/L

Fe(tot) = .14 mg/L

Tag # 00170 & 00171

Measured Discharge @ adit
opening (Volumetric)

0940 Collected Blank samples

00172 is Diss. Metals w/ Filter

00173 is Blank bottle

Discharge:

.8 gal / 4 sec

.8 gal / 4 sec

.75 gal / 3.5 sec

* approx. 20% of flow

TAS

1-22-97

was not

measured



001-046

TAS/SES

1-22-97

TAS/SES

1-22-97

001-047

DR-7-SW

Silver Swan Adit

1100 pH = 6.48 @ 7.5°C

EC = 731 μ S/cm @ 60°C

DO = 7.8 mg/L @ 7.0°C

Fe(II) = 4.0 mg/L

Fe(tot) = 6.8 mg/L

Alk = 496 mg/L as CaCO_3

Collected Samples @ Seep Source

Attempted to measure discharge

@ culvert, but there is not enough drop (backwater into culvert).

Seep Source is about 2' lower

in elevation than last sample round

Flow is approx. the same as

last sampling round (Oct. 96)

Tag # 00174 & 00175

DR-6-SW Silver Swan Wetland

Discharge - No observable flow
into Dolores River. Entire area
covered w/ 2-3 ft of snow

749

001-048

TAS/SES

TS
1-22-97

TAS/SES

1-22-97

001-049

DR-9-SW Santa Cruz Wetland Discharge

1220

pH = 7.93 @ 1.8°C

EC = 397 μ S/cm @ 2.0°C

DO = 11.2 mg/L @ 5.0°C

Fe (II) = .30 mg/L

Fe (tot) = .48 mg/L

ALK = 276 mg/L as CaCO_3

Tag # 00176 & 00177

Collect +1 sample 8' up
from confluence w/ Dolores

Moderate flow into river, but
flow isn't channelized - most
is flowing from under snowbanks.
Did not measure flow here

TS
1-22-97

001-050

TAS/SES

1-22-97

1430

DR-1-SW Columbia Tailings Seep
Channel 40 ft up from Dolores

River Confluence

pH = 7.04 @ 1.8°C

EC = 283 μ S/cm @ 2.1°C

DO = 13.0 mg/L @ 3.0°C

Fe(II) = 4.6 mg/L

Fe(tot) = 5.0 mg/L

ALK = 177 mg/L as CaCO_3

Tag numbers #00178 & 00179

Discharge Measurement by
floatation method

1440

Distance	Depth	Ave time for 1 ft
0.00	0.40	2.5 sec
0.25	0.52	3.0 sec
0.50	0.62	2.0 sec
0.75	0.44	3.0 sec
1.00	0.48	3.5 sec
1.25	0.31	3.0 sec
1.50	0.22	4.5 sec
1.75	0.30	0 vel
2.00	0.15	0 vel
2.25	0.05	10 sec

TAS/SES

1-22-97

001-051

DR-1-SW (Continued)

2.50 0.10 13 sec

2.75 0.06 13 sec

3.00 0.05 14 sec

3.25 0.05 14 sec

3.50 0.00 0 velocity

1-23-97

Weather: Snowing, calm, 1/2 ft
of snow past 12 hoursDR-4-SW Dolores River - Downstream
Ice on edge of channel

0900 pH = 8.32 @ 1.1°C

EC = 235 μ S/cm @ 1.4°C

DO = 13.8 mg/L @ 1.0°C

Fe(II) = .12 mg/L

Fe(tot) = .17 mg/L

ALK = 147 mg/L @ ~~4.5~~ ^{TS}

Tag # 180 & 181

001-052

1-23-97

TAS/SES

DR-18-SW Dolores River @
old bridge abutment.

0925

pH = 8.98 @ 0.4°C

EC = 219 μ S/cm @ 0.5°C

DO = 14.8 mg/L @ 0.4°C

Fe(II) = 0.16 mg/L

Fe(tot) = 0.16 mg/L

ALK = 128 mg/L as CaCO_3

tag # 00182 & 00183

Ice on channel edge

DR-2-SW West Rico Bridge
Dolores River

1030

pH = 8.15 @ 0.3°C

EC = 219 μ S/cm @ 0.3°C

DO = 15.0 mg/L @ 0.5°C

Fe(II) = 0.05 mg/L

Fe(tot) = 0.09 mg/L

ALK = 112 mg/L as CaCO_3

Tag # 00184 & 00185

1030

Collected Duplicate
Samples

Tag # 00186 & 00187

001-053

TAS

1-23-97

001-054

TAS

WKS

4-16-97

SURFACE WATER MONITORING

CREW: TODD SULLIVAN (ESA)

BILL SCHENDERLEIN (ESA)

WEATHER: Clear, Calm, 50°F

Rapid snowmelt, 2' of snow

SVS-5 Upstream of Argentine
Tailings. Moderate Flow

1120

pH = 8.44 @ 1.8°C

EC = 11.9 μ S/cm @ 1.9°C

DO = 14.0 mg/L @ 2.2°C

Fe(II) = 0.01 mg/L

Fe (tot) = 0.84 mg/L

Alkalinity = 191 mg/L

Tag #s 00188 & 00189

Measured Discharge 10' upstream of Culvert

1130

Collected Samples 30' upstream of Culvert

1116

pH Calibration:

(7) = 7.03 @ 16.9°C

(10) = 10.15 @ 12.5°C

TAS/WKS

4-16-97

001-055

SVS-12 Argentine Tailings Seep - Low Flow
Rust Coated Rocks in channel

1230 pH = 6.72 @ 10.5°C

EC = 807 μ S/cm @ 9.7°C

DO = 8.3 mg/L @ 11.1°C

Fe(II) = 10.8 mg/L

Fe (tot) = 11.8 mg/L

Alkalinity = 150 mg/L as CaCO₃

Tag #s 00190 & 00191

1250 Collected Samples

Fluor Reading 0.24

channel

SVS-11 Argentine Seep above Confluence w/ Silver
Creek. Seep channel has rust stain

1330 pH = 7.61 @ 9.6°C

EC = 810 μ S/cm @ 9.1°C

DO = 11.2 mg/L @ 9.0°C

Fe(II) = 1.92

Fe (tot) = 3.82

Alkalinity = 127 mg/L

Tag #s 00192 & 00193

1400 Collected Sample

001-056

4-16-97

TAS/WKS

1438

SVS-8 Silver Creek below
Culvert

pH = 7.81 @ 5.0°C

EC = 176 μ S/cm @ 5.0°C

DO = 13.5 mg/L @ 5.0°C

Fe(II) = 0.07 mg/L

Fe(tot) = 0.81 mg/L

MB

1500

Alkalinity = 86 mg/L as CaCO_3
Collected Samples

1510

Measured discharge below culvert 25'
Tag # 00194 & 00195

Headed back to room to drop off samples

1720

DR-16-SW Rico Bay Adit.
low flow and abundant algae

pH = 7.42 @ 11.8°C

EC = 1060 μ S/cm @ 11.6°C

DO = 9.2 mg/L @ 12.0°C

Fe(II) = 0.04 mg/L

Fe(tot) = 0.23

V

Alkalinity = 460 mg/L

1730

Collected Samples

Tag #s 00196 & 00197

4/16/97

TAS/WKS

001-057

DR-16 (continued) Measured Discharge
Volumetrically @ culvert outlet

1745

#1 1.8 gallons / 17.2 sec

#2 1.9 gallons / 17.4 sec

#3 1.7 gallons / 15.6 sec

DR-8-SW Santa Cruz Adit.
low flow, some algae

1800

pH = 7.17 @ 15.0°C

EC = 1131 μ S/cm @ 15.1°C

DO = 6.2 mg/L @ 14.8°C

Fe(II) = 0.01 mg/L

Fe(tot) = 0.20 mg/L

Alkalinity = 645 mg/L as CaCO_3

1810

Collected Samples Tag # 00198 & 00199

1810

Collected Samples Tag # 00200 & 00201

Measured Discharge Volumetrically @ adit

#1

1 gallon / 2.0 sec

#2

1 gallon / 2.5 sec

#3

1 gallon / 1.7 sec

* Only able to capture 80% of flow
due to adit structure conditions.

001-058

4/17/97

TAS WKS

Weather: Clear, Calm ~ 30°F, snow cover

DR-1-SW DOLORES RIVER E. CHANNEL @

0830

COLUMBIA TAILINGS

pH = 6.22 @ 3.1°C

EC = 385 μ S/cm @ 3.7°C

DO = 11.4 mg/L @ 4.0°C

Fe(II) = 5.2 mg/L

Fe(tot) = 13.5 mg/L

Alkalinity = 125 mg/L as CaCO_3

0900

Collected Samples: Tag #s 00202 & 00203

Measured discharge w/ Marsa McBirney

DR-9-SW Santa Cruz Wetland

1100

Discharge East - Low flow, clear water/channel

pH = 7.26 @ 6.8°C

EC = 329 μ S/cm @ 6.7°C

DO = 12.2 mg/L @ 7.5°C

Fe(II) = 0.09 mg/L

Fe(tot) = 0.33 mg/L

Alkalinity = 175 mg/L as CaCO_3

1120

Collected Samples Tag # 00204 & 00205

Measured Flow

Used Hand Pump & Filter

4/17/97

TAS WKS

001-059

DR-10-SW Santa Cruz Wetland Discharge West

1130 low flow, non channelized

pH = 7.33 @ 12.3°C

EC = 1002 μ S/cm @ 12.0°C

DO = 11.3 mg/L @ 13.0°C

Used Hand Pump & Filter

Fe(II) = 0.03 mg/L

Fe(tot) = 0.04 mg/L

Alkalinity = 530 mg/L as CaCO_3

1140 Collected Samples - Tag # 00206 & 00207

No Flow measurement taken

DR-8-SW Silver Swan Wetland Discharge

1300 Moderate flow - Clear, little Fe precip.

pH = 7.04 @ 11.9°C

EC = 262 μ S/cm @ 12.5°C

DO = 12.0 mg/L @ 12°C

Fe(II) = 0.03 mg/L

Fe(tot) = 0.16 mg/L

Alkalinity = 135 mg/L as CaCO_3

1320 Collected Sample - Tag # 00208 & 00209

Discharge Measured @ outlet

Used Hand Pump & Filter

001-060

4/17/97

THS WKS

15a
DR-17-SW Sulfur Creek above

1330 Wetland ponds - 10' upstream

pH = 8.06 @ 6.7°C

EC = 96.7 μ S/cm @ 6.8°C

DO = 13.4 mg/L @ 7.0°C

Fe(II) = 0.05 mg/L Used Hand

Fe(tot) = 0.00 mg/L Pump & Filter

Alk = 52 mg/L as CaCO_3

1340 Collected Samples Tag # 00210 & 00211

Measured Discharge 20' above confluence

→ Volumetric = 1.26 gpm

DR-7-SW Silver Swan Adit

1425 Very Rusty Channel - low flow

pH = 5.90 @ 11.4°C

EC = 724 μ S/cm @ 11.9°C

DO = 4.3 mg/L @ 12°C

Fe(II) = 2.3 mg/L

Fe(tot) = 2.5 mg/L

Alkalinity = 420 mg/L as CaCO_3

1425 Collected Sample - Tag # 00212 & 00213

4/18/97

THS WKS

001-061

0800 Weather: Clear, Calm, ~25°F

DR-4-SW Delores R. @ Connetquot

pH = 7.04 @ 3.1°C

EC = 191 μ S/cm @ 3.1°C

DO = 13.5 mg/L

Fe(II) = 0.08 mg/L

Fe(tot) = 0.19 mg/L

Alkalinity = 100 mg/L as CaCO_3

0900 Collected Sample - Tag # 00214 & 00215

Measured Discharge

1030 DR-18-SW Delores River at

old bridge abutment - moderate flow

pH = 6.92 @ 5.9°C

EC = 200 μ S/cm @ 5.9°C

DO = 12.6 mg/L

Fe(II) = 0.07 mg/L

Fe(tot) = 0.19 mg/L

Alkalinity = 88 mg/L as CaCO_3

1045 Collected Sample - Tag # 00216 & 00217

Measured Discharge

001-062

4/18/97

TAS, WKS

DR-2-SW Dolores River

1200 @ West Rio Bridge

pH = 7.03 @ 5.7°C

EC = 195 μ S/cm @ 6.1°C

DO = 12.2 mg/L

Fe(II) = ^{0.02}~~0.08~~ mg/LFe(tot) = ^{0.14}~~0.19~~ mg/L

Alkalinity = 122 mg/L as

1220 Collected Sample - Tag # 00218 & 00219

1220 Collected Filter Blank (Cartridge) Tag # 00220

1220 Collected Filter Blank (Hand Pump) Tag # 00221

1220 Collected Bottle Blank Tag # 00222

1300 Prepped Coolers

1440 Left site

TAS

4/18/97

4/18/97

TAS, WKS

001-063

15a
DR-17-SW Volumetric Flow measurement

1350 1.9 gal 1.74 sec → 1.09 gpm

1.9 gal 1.97 sec → 0.96 gpm

2.0 gal 1.85 sec → 1.08 gpm

1.9 gal 1.89 sec → 1.01 gpm

2.0 gal 1.81 sec → 1.10 gpm

ave 1.048 gpm

* 20% of flow was seeping past
bucket. Add 20% to calculated flow

1.048 x .2 = .2096

+ 1.048

1.2576 GPM

001-064

7-29-97

T.A.S. WKS

POST CONSTRUCTION SURFACE- WATER MONITORING @ RICO

CREW: TODD SULLIVAN (ESA)
BILL SCHENDERLEIN (ESA)

WEATHER: OVERCAST, SLIGHT BREEZE
~ 65°F. VERY HEAVY RAIN THE
PAST 72 HOURS.

0900 ARRIVED @ RICO. Surveyed the area.

SVS-5 SILVER CREEK ABOVE CULVERT NEAR MILL

0930 Arrived at location
pH Calibration:
pH(7) = 7.02 @ 18.6°C
pH(10) = 10.08 @ 18.4°C

1020 pH = 7.55 @ 8.0°C
EC = 111.6 µS/cm @ 8.4°C
DO = 12.8 mg/L @ 9.0°C
ALK = 69 mg/L as CaCO₃
Fe(II) = ~~1.39~~ 0.18 mg/L Fe(tot) = 1.39 mg/L

7-29-97

TAS. WKS

001-065

SVS-5 cont.

Diss Metals

TDS, TSS, SO₄

1030 Collected Sample Tag # 00221 & 00222
1115 Measured discharge w/ Marsh-McBirney
RMB 2000 Flow Meter. Q = 1.64 cfs

1130 Measured pH @ Blaine Adit pH = 1.94.
pH @ Blaine Adit flow confluence w/ Silver Crk
= 7.00. pH of Silver Crk above Adit
= 7.71. Adit flow ~ 2 GPM.

SVS-8 SILVER CREEK BELOW CONFLUENCE WITH ARGENTINE TAILINGS SEEP.

1230 Arrived @ Location
pH = 7.46 @ 10.1°C
EC = 169 µS/cm @ 10.3°C
DO = 11.8 mg/L @ 10.0°C
ALK = 70 mg/L as CaCO₃
Fe(II) = 0.02 mg/L
Fe(tot) = 1.16 mg/L

1232 Collected Sample 10' below culvert
Tag # 00223 & 00224

1232 Collected Duplicate Samples

Tag # 00225 & 00226

1254 Collected Discharge Measurement w/ Flow meter

001-066

7-29-97

TAS, WKS

SVS-11 Argentine Seep Flow above confluence w/ Silver Creek

1340 Arrived @ location - Fe-stain on Rocks
non channelized flow. Est @ 30 GPM

pH = 7.34 @ 16.0°C

EC = 1055 μ S/cm @ 15.9°C

DO = 6.6 mg/L @ 16°C

Alk = 133 mg/L as CaCO_3

Fe (II) = 3.02 Fe (tot) = 4.41 mg/L

1355 Collected Sample @ confluence
Tag # 00227 & 00228

TAS

7-29-97

7-29-97

TAS, WKS

001-067

SVS-12 Argentine Tailings Seep

1450

Arrived @ Location

Low flow - heavy Fe-stain

Flume Reading = 10.27

pH = 6.46 @ 8.5°C

EC = 822 μ S @ 9.4°C

DO = 9.2 mg @ 9.0°C

Fe (II) = 7.0 mg/L Fe (tot) = 12.6 mg/L

Alk = 138 mg/L as CaCO_3

1510 Collected Samples Tag # 00229 to 00232

3 main seeps contributing to seep flow measured

EC = 881 μ S/cm @ seep 40' SE of sample point

pH = 6.70

1620 Finished Sampling. Surveyed construction & reclamation & recorded results, took pictures 20.6.24.

TAS

7-29-97

001-065

7-30-97

THS WKS

SW Sampling

0800

Weather: Overcast, light rain, ~60°F
 Rained steady all night last night.

RICO BOY ADIT (DR-16-SW)

0820

arrived @ location, low flow,
 algae in channel. Approximately
 50% of measured flow is coming
 from collapsed adit ~20 ft to north of
 main adit marked 'Rico Boy'. The north
 adit flow has never been observed during
 other sampling events due to snow cover.

pH = 6.29 @ 12.9°C

EC = 819 μ S/cm @ 12.6°C

DO = 8.4 mg/L @ 13°C

ALK = 695 mg/L

Fe(II) = 0.21 mg/L Fe(tot) = 0.80 mg/L

Collected Samples 10' down from main adit.

Measured Discharge w/ 5 gal bucket.

Tag # 00233 & 00234

Vol	Time (sec)
1.5 gal	14.6
1.6	15.26
1.8	15.07

7-30-97

THS WKS

001-069

SANTA CRUZ ADIT (DR-8-SW)

1000

arrived @ location.

pH = 6.28 @ 15.8

EC = 1103 μ S/cm @ 16.1°C

DO = 5.9 mg/L @ 16.5°C

ALK = 555 mg/L as CaCO₃

Fe(II) = 0.00 mg/L

Fe(tot) = 0.09 mg/L

1030

Collected Sample @ Adit Gate

Tag # 00235 & 00236

~~Measured Discharge~~ Discharge from adit is
 not measurable due to back water condition.
 Based on prior measurements & observed
 flow @ is estimated to be ~25 GPM.

SANTA CRUZ WETLAND DISCHARGE WEST
(DR-10-SW)

1100

arrived @ location

SANTA CRUZ WETLAND DISCHARGE EAST
(DR-9-SW)

1120

arrived @ location

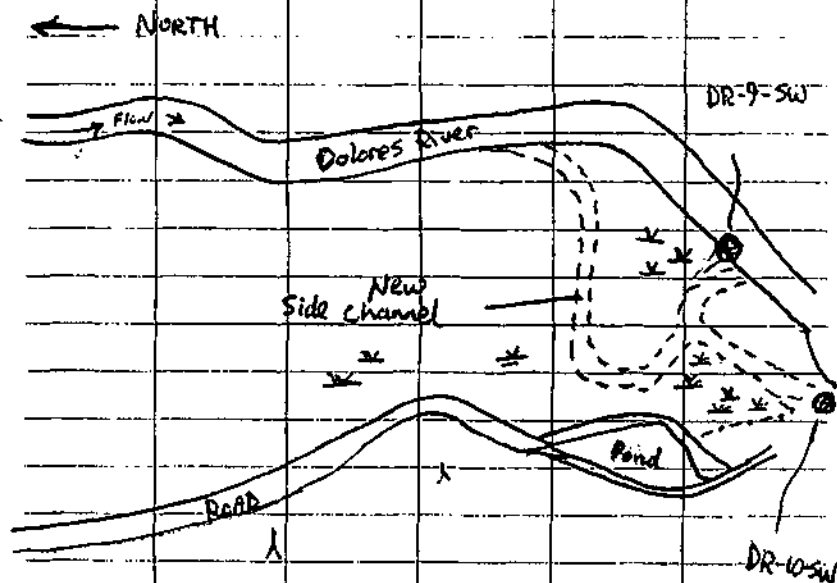
* Both of the wetland discharge stations have
 become inundated with Dolores River flow &
 will not be sampled this event.

00V-070

7-30-97

TAS WKS

SANTA CRUZ WETLAND DISCHARGE STATIONS (Continued).



Due to the new path (side channel) of the Dolores River, Sampling Stations DR-9-SW & DR-10-SW do not represent wetland discharge points. Instead they represent mainly the water quality of the Dolores River side channel. Due to the objective of comparative analyses at those stations as wetland discharge points, they will not be sampled.

7-30-97

TAS WKS

01-071

01-00

DOLORES RIVER at West Rico Bridge (DR-2-SW)

1240 Arrived at location, very high flow, muddy water. Too high to wade.

pH = 7.33 @ 10.2°C

EC = 111.3 @ 10.1°C

DO = 11.6 mg/L @ 10°C

ALK = 47 mg/L

Fe(II) = 0.02 mg/L Fe(tot) = 0.60 mg/L

300 Collected ^{Samples} Discharge. Tag # 00237 & 00238
Discharge not collected due to the danger of wading the river.

DOLORES RIVER at Old Bridge Abutment (DR-18-SW)

1415 Arrived @ Location. River is very high & muddy & is flowing in several channels at this location.

pH = 7.31 @ 10.3°C

EC = 103.3 µS/cm @ 10.6°C

DO = 11.2 mg/L @ 11.0°C ALK = 46 mg/L

Fe(II) = 0.01 mg/L Fe(tot) = 1.30 mg/L

1430 Collected Sample on far east bank
No discharge collected due to the danger of the swollen river.

Tag # 239, 2 Blanks
240.3
241 - Diss. Metals
242 - TDS TSS SO₄

01-072

~~01-07~~

7/30/97

TAS, WKS

DOLORES RIVER down from Cemetery
(DR-4-SW)

1500 Arrived @ Location, very high flow, muddy
 pH = 6.88 @ 10.6°C
 EC = 117 μ S/cm @ 10.8°C
 DO = 12 mg/L @ 11.0°C
 Alk = 48 mg/L
 Fe(II) = 0.03 mg/L Fe(tot) = 1.13 mg/L

1515 Collected Sample from east bank
 No discharge measurement taken. Not
 wadeable.
 Tag # 00243 & 00244

DOLORES RIVER EAST CHANNEL BELOW
COLUMBIA TAILINGS (DR-1-SW)

1545 Arrived @ Location, high flow, muddy
 pH = 7.20 @ 10.5°C
 EC = 98.6 μ S/cm @ 10.6°C
 DO = 11.8 mg/L @ 11°C
 Alk = 44 mg/L as CaCO₃
 Fe(II) = 0.15 mg/L Fe(tot) = 1.24 mg/L

1550 Collected Sample on east bank 20'
 above confluence. Tag # ~~00243~~ ~~00244~~ TS
 00245 00246

TAS, WKS

7/30/97

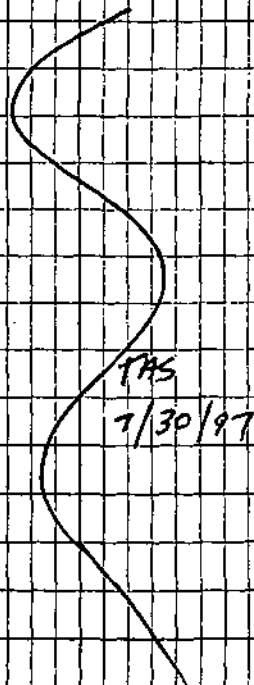
01-073

DR-1-SW (continued)

1630 Measured Discharge w/ Marsh McBratney
 20 ft up from confluence.

1700 Surveyed the Dolores River, took
 pictures & recorded its new flow paths

1730 Left site - back to town



01-074

7/31/97

TAS, WKS

WEATHER: No rain for past 12 hrs
Overcast w/ low thick clouds.

SANTA CRUZ WETLAND DISCHARGE WEST
(DR-10-SW)

0900 Arrived @ location. DOLORES RIVER
has recently formed a west side channel
that coningles with this wetland discharge
channel ~ 150 ft upstream from
normal sampling point. We sampled
the wetland discharge flow just
above the confluence w/ Dolores River.
pH = 7.00 @ 14.2°C
EC = 947 μ S/cm @ 13.9°C
DO = 8.0 mg/L @ 14.0°C
Alk = 450 mg/L as CaCO_3
Fe(II) = ~~0~~ Fe(tot) = 0.12 mg/L

0915 Collected Sample, Tag = 00247 & 00248

Attempted to measure discharge but
flow is non channelized/overland.
~~Visual~~ Visually estimated to
be ~ 1.5 gallons/minute.

7/31/97

TAS, WKS

01-075

(DR-10-SW) continued.

After 3 attempts of measuring Fe(II),
we believe there is something in the
sample that is interfering with the
Fe(II) reagent. The longer ^{the} sample
remains in decuvac vial, the more turbid
it got, causing the colorimeter to falsely
record a higher value.

SILVER SWAN WETLAND DISCHARGE
(DR-6-SW)

1000 Arrived @ location. Clear flow, several
small channels are discharging to Dolores River
from wetland.
pH = 6.26 @ 12.8°C
EC = 202.7 μ S/cm @ 12.9°C
DO = 10.4 mg/L @ 13°C
Alk = 97 mg/L as CaCO_3
Fe(II) = 0.13 mg/L Fe(tot) = 0.40 mg/L

1040 Collected Sample Tag = 00249 & 00250

1050 Measured Discharge 20' above confluence

Ed Schneider on Monday reworked Sulphur Crk
channel so some flow would go back into the
design channel. He also removed debris on the
upper pond spillway so it wasn't breaching the
dam anywhere else.

1-76

7/31/97

TAS

SULPHUR CREEK DISCHARGE TO SILVER SWAN WETLAND FORG (DR-5a-SW)

1100 Arrived at site. Recent runoff has split the drainage to where ^{orig} flow has drained around culvert & is flowing back into the design channel, the other flow is 60 ft to the south of design channel & it flows into the upper pond.

pH = 7.69 @ 11.4°C

EC = 99.8 $\mu\text{S}/\text{cm}$ @ 11.6°C

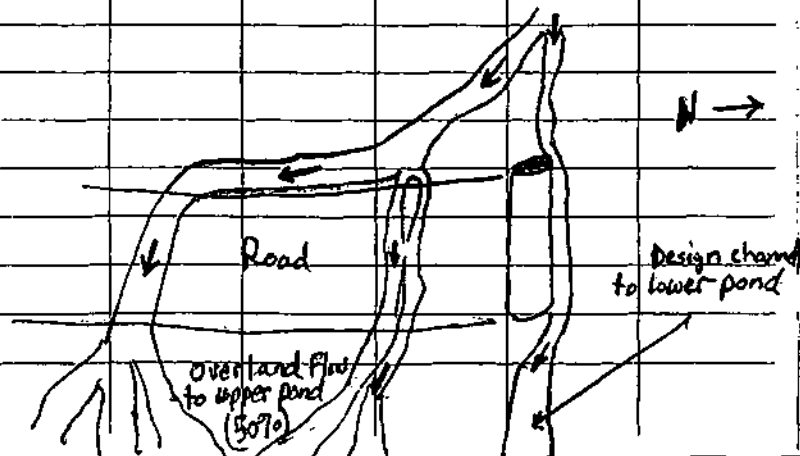
DO = 10.7 mg/L @ 12°C

Fe(II) = 0.00

Fe(tot) = 0.00

Alk = 415 mg/L

1100 Collected Sample 10' above discharge to lower pond. Tag # 00251 & 00252



7/31/97

TMS/WKS

1-77

SILVER SWAN ADIT (DR-7-SW)

1130 Arrived at location, low flow, Fe stain

pH = 5.70 @ 10.7°C

EC = 702 $\mu\text{S}/\text{cm}$ @ 11.3°C

DO = 6.0 mg/L @ 11°C

Alk = 415 mg/L as CaCO_3

Fe(II) = 3.09 mg/L Fe(tot) = 3.21 mg/L

1130 Collected Sample 10' down from origin

Tag # 00253 & 00254

After collecting samples from all locations we spent 1 hour redirecting Sulphur Creek into its design culvert & channel. All unwanted flow outside of the design channel was completely sealed off and it appears that flow will remain in culvert now.

1300 Packed coolers w/ samples.

1400 Checked out left Rico to drop off samples @ UPS in Montrose.

**C2 Surface Water Sampling
Forms**



ESA CONSULTANTS INC.

SURFACE WATER SAMPLING FORM

Station ID: SVS-5 Project Name: RicoLocation: Silver Crk upstream from Argentine Tailings AreaDate: 10/22/96 Time: 10:26 Gage Height: NAWeather Conditions: Clear Sky, 10°F, slush & ice in channel,Sampling Personnel (Signature): [Signature]

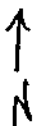
FIELD MEASUREMENTS

pH/Temp: 8.04 / 0.0°CElev 925 ft
Dissolved Oxygen (mg/L): 14.8 @ 0.0°C (field)
DO Corrected $14.8 \times 0.70 = 10.4$ mg/L
Calculated Streamflow (cfs): 1.64Alkalinity (mg/L as CaCO₃): 50.0Specific Conductance/Temp. (μS): 112 / 0.0°CFe (II)(mg/L): ^{.02}~~0.20~~ rs Fe (total)(mg/L): 0.41COMMENTS: Recent snow melt

WATER QUALITY SAMPLES

Tag No.	Date/Time	Filtered	Preserved	Analysis
<u>00123</u>	<u>10/22/96 1201</u>	<u>yes</u>	<u>HNO₃</u>	<u>Dissolved Metals, Hardness</u>
<u>00124</u>	<u>" "</u>	<u>no</u>	<u>—</u>	<u>TDS, TSS, SO₄</u>

Site Sketch:





ESA CONSULTANTS INC.

SURFACE WATER SAMPLING FORM

Station ID: SVS-8 Project Name: RicoLocation: Silver Crk below Argentine Seep ConfluenceDate: 10/27/96 Time: 1:40 Gage Height: NAWeather Conditions: Clear sky, snow on banksSampling Personnel (Signature): [Signature]

FIELD MEASUREMENTS

pH/Temp: 8.04/2.7°CDissolved Oxygen (mg/L): 9.8 @ 4.0°C (field)DO Correction = $9.8 \times 0.71 = 7.0$ mg/LAlkalinity (mg/L as CaCO₃): 101Calculated Streamflow (cfs): 2.32Specific Conductance/Temp. (µS): 183/3.3°CFe (II)(mg/L): .07 Fe (total)(mg/L): .54COMMENTS: Clear water, rocks are stained orange

WATER QUALITY SAMPLES

Tag No.	Date/Time	Filtered	Preserved	Analysis
<u>00125</u>	<u>10/22/96 2:15</u>	<u>Yes</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00126</u>	<u>" "</u>	<u>No</u>	<u>—</u>	<u>TDS, TSS, SO₄</u>

Site Sketch:

Sampled 30'
down from bridge



ESA CONSULTANTS INC.

SURFACE WATER SAMPLING FORM

Station ID: SUS-11 Project Name: RicoLocation: Argentine seep flow above Silver Crk ConfluenceDate: 10/22/96 Time: 3:00 Flume
Gage Height: .22'Weather Conditions: Clear Sky, snow on banks ~ 35°FSampling Personnel (Signature): [Signature]

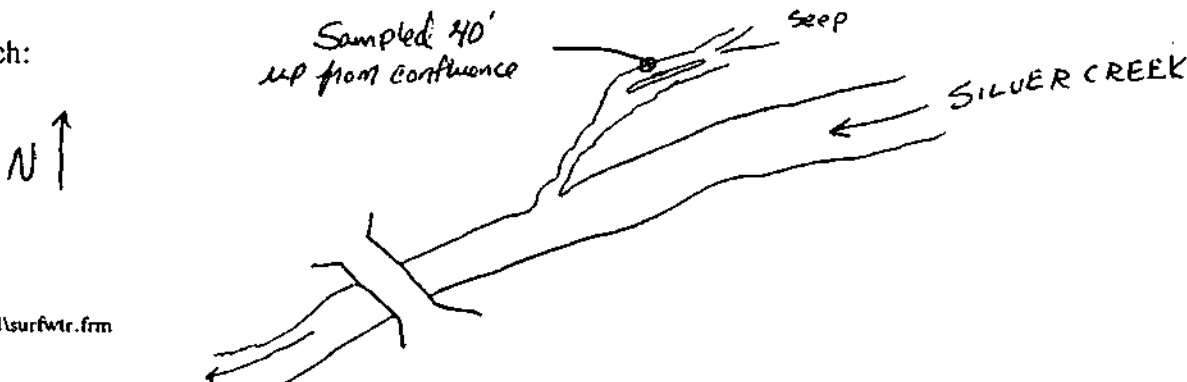
FIELD MEASUREMENTS

pH/Temp: 7.61 / 8.3Elev 9130 ftDissolved Oxygen (mg/L): 4.4 @ 10°C (field)DO Correction = $4.4 * 0.71 = 3.1 \text{ mg/L}$ Alkalinity (mg/L as CaCO_3): 98Calculated Streamflow (cfs): Not Measured
Non-ChannelizedSpecific Conductance/Temp. (μS): 721 / 8.2°CFe (II)(mg/L): 2.60 Fe (total)(mg/L): 7.40COMMENTS: Clear water, reddish orange sediment

WATER QUALITY SAMPLES

Tag No.	Date/Time	Filtered	Preserved	Analysis
<u>00127</u>	<u>10/22/96 3:05</u>	<u>yes</u>	<u>HNO3</u>	<u>Diss. Metals, Hardness</u>
<u>00128</u>	<u>" "</u>	<u>No</u>	<u>—</u>	<u>TDS, TSS, SO_4</u>

Site Sketch:





ESA CONSULTANTS INC.

SURFACE WATER SAMPLING FORM

Station ID: SVS-12 Project Name: Rico
Location: Argentine Tailings Sump
Date: 10/22/96 Time: 4:00 Gage Height: _____
Weather Conditions: Clear Sky, snow on banks, ~ 50°F
Sampling Personnel (Signature): [Signature]

FIELD MEASUREMENTS

pH/Temp: 7.11 / 6.0°C Elev 9,170 ft
Dissolved Oxygen (mg/L): 4.4 (field)
DO Correction = $4.4 * 0.71 = 3.1 \text{ mg/L}$
Alkalinity (mg/L as CaCO_3): 116 Calculated Streamflow (cfs): 0.10
Specific Conductance/Temp. (μS): 501 / 6.3°C
Fe (II)(mg/L): 5.90 Fe (total)(mg/L): 6.80

COMMENTS: Clear water, slightly stained w/ Fe Oxides, much cleared since Pre VCUP

WATER QUALITY SAMPLES

Tag No.	Date/Time	Filtered	Preserved	Analysis
00129	10/22/96 4:25	yes	HNO_3	Diss. Metals, Hardness
00130		no	—	TDS TSS SO_4
00131		no	NaOH	Cyanide
00132		no	HCl	PCE
00133		no	HCl	PCE
00134		no	HCl	PCE
00135		yes	HNO_3	Diss Metals, Hardness
00136		no	—	TDS TSS SO_4
00137		no	NaOH	Cyanide
Site Sketch:				
00138		no	HCl	PCE
00139		no	HCl	PCE
00140		no	HCl	PCE



ESA CONSULTANTS INC.

SURFACE WATER SAMPLING FORM

Station ID: DR-1-SW Project Name: Rico
Location: East Channel of Dolores R. 40' up from confluence w/ Main Stem
Date: 10/23/96 Time: 3:40 Gage Height: NA
Weather Conditions: Cloudy, Windy ~ 45°F
Sampling Personnel (Signature): [Signature]

FIELD MEASUREMENTS

pH/Temp: 6.49 / 6.8°C Dissolved Oxygen (mg/L): 2.7 @ 7.0°C (field)
Alkalinity (mg/L as CaCO₃): 97 DO Correction = $2.7 \times 0.72 = 1.9$ mg/L
Calculated Streamflow (cfs): 0.377
Specific Conductance/Temp. (µS): 270 / 7.3°C
Fe (II)(mg/L): 5.7 Fe (total)(mg/L): 6.6
COMMENTS: Orange Stained Rocks - filmy sheen on water

WATER QUALITY SAMPLES

Tag No.	Date/Time	Filtered	Preserved	Analysis
<u>00153</u>	<u>10/23/96 3:50</u>	<u>yes</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00154</u>	<u>" "</u>	<u>No</u>	<u>—</u>	<u>TDS, TSS, SO₄</u>
<u>00155</u>	<u>" "</u>	<u>No</u>	<u>NaOH</u>	<u>Cyanide</u>

Site Sketch:



ESA CONSULTANTS INC.

SURFACE WATER SAMPLING FORM

Station ID: DR-2-SW Project Name: Rico

Location: West Rico Bridge - East Side of Dolores River

Date: 10/24/96 Time: 1100 Gage Height: NA

Weather Conditions: Clear, Calm ~ 45°F

Sampling Personnel (Signature): J. Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.51 / 1.4°C

Elev 8,700 ft
Dissolved Oxygen (mg/L): 14.8 @ 2°C mg/L (Sick)
DO Correction = $14.8 \times 0.72 = 10.7$ mg/L
Calculated Streamflow (cfs): 40.7

Alkalinity (mg/L as CaCO₃): 121

Specific Conductance/Temp. (μS): 184 / 2.0

Fe (II)(mg/L): 0.03 Fe (total)(mg/L): 0.09

COMMENTS: _____

WATER QUALITY SAMPLES

Tag No.	Date/Time	Filtered	Preserved	Analysis
<u>00160</u>	<u>10/24/96 1105</u>	<u>yes</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00161</u>	<u>" "</u>	<u>No</u>	<u>—</u>	<u>TDS TSS SO₄</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Site Sketch:



ESA CONSULTANTS INC.

SURFACE WATER SAMPLING FORM

Station ID: DR-4-SW Project Name: RicoLocation: Dolores River near the Rico CemeteryDate: 10/24/96 Time: _____ Gage Height: NAWeather Conditions: Clear sky, ~ 5°F Water Temp is 0°CSampling Personnel (Signature): [Signature]

FIELD MEASUREMENTS

pH/Temp: 7.59 0.0°CElev 9600 ft.
Dissolved Oxygen (mg/L): 13 @ 0.0°C (field)DO Correction = $13 \times 0.72 = 9.4$ mg/LAlkalinity (mg/L as CaCO₃): 114Calculated Streamflow (cfs): 38.8Specific Conductance/Temp. (μS): 183/ 0.2°CFe (II)(mg/L): 0.19 Fe (total)(mg/L): 0.21COMMENTS: Sampled from E. bank

WATER QUALITY SAMPLES

Tag No.	Date/Time	Filtered	Preserved	Analysis
<u>00156</u>	<u>10/24/96 9:00</u>	<u>yes</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00157</u>	<u>" 9:00</u>	<u>No</u>	<u>—</u>	<u>TDS TSS SO₄</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
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Site Sketch:



ESA CONSULTANTS INC.

SURFACE WATER SAMPLING FORM

Station ID: DR-6-SW Project Name: PicoLocation: Silver Swan Wetlands outflow to Dolores R.Date: 10/23/96 Time: 1040 Gage Height: NAWeather Conditions: Clear, Calm, ~40°F patchy snow on groundSampling Personnel (Signature): [Signature]

FIELD MEASUREMENTS

pH/Temp: 7.32 / 4.1Elev 8670 ft
Dissolved Oxygen (mg/L): 6.3 @ 4.0°C (field)
DO Correction $6.3 * 0.72 = 4.5$ mg/LAlkalinity (mg/L as CaCO₃): 134Calculated Streamflow (cfs): 0.07Specific Conductance/Temp. (μS): 226 / 4.0Fe (II)(mg/L): .06 Fe (total)(mg/L): .09COMMENTS: clean channel (no Fe staining)

WATER QUALITY SAMPLES

Tag No.	Date/Time	Filtered	Preserved	Analysis
<u>00143</u>	<u>10/23/96 10:40</u>	<u>yes</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00144</u>	<u>" "</u>	<u>no</u>	<u>—</u>	<u>TDS, TSS, SO₄</u>

Site Sketch:



ESA CONSULTANTS INC.

SURFACE WATER SAMPLING FORM

Station ID: DR-7-SW Project Name: PicoLocation: Silver Swan adit seep - 2' from originDate: 10/23/96 Time: 0900 Gage Height: NAWeather Conditions: Clear, patches of snow on ground ~15°FSampling Personnel (Signature): [Signature]

FIELD MEASUREMENTS

pH/Temp: 5.95 / 11.2°CElev 8675 ft
Dissolved Oxygen (mg/L): 4.6 @ 11.0°C (field)
DO Correction = $4.6 \times 0.72 = 3.3$ mg/L
Calculated Streamflow (cfs): 0.024Alkalinity (mg/L as CaCO₃): 564Specific Conductance/Temp. (μS): 868 / 10.1°CFe (II)(mg/L): 8.6 Fe (total)(mg/L): 9.2COMMENTS: Fe staining in channel

WATER QUALITY SAMPLES

Tag No.	Date/Time	Filtered	Preserved	Analysis
<u>00141</u>	<u>10/23/96 9:15</u>	<u>yes</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00142</u>	<u>" "</u>	<u>no</u>	<u>—</u>	<u>TDS, TSS, SO₄</u>

Site Sketch:



ESA CONSULTANTS INC.

SURFACE WATER SAMPLING FORM

Station ID: DR-8-SW Project Name: RicoLocation: Santa Cruz Aclit, Sampled @ edit doorDate: 10/23/96 Time: 2:40 Gage Height: NAWeather Conditions: Cloudy, breezy, ~45°F, patches of snowSampling Personnel (Signature): [Signature]

FIELD MEASUREMENTS

pH/Temp: 6.50 / 17.0°C Elev 8690 ft
Dissolved Oxygen (mg/L): 4.9 @ 16.5°C (field)Alkalinity (mg/L as CaCO₃): 690 DO Correction = $4.9 + 0.72 = 3.5 \text{ mg/L}$
Calculated Streamflow (cfs): 0.018Specific Conductance/Temp. (μS): 1178 / 15.4°CFe (II)(mg/L): 0.01 Fe (total)(mg/L): 0.14COMMENTS: little Fe staining on rocks, abundant algae

WATER QUALITY SAMPLES

Tag No.	Date/Time	Filtered	Preserved	Analysis
<u>00151</u>	<u>10/23/96 2:45</u>	<u>yes</u>	<u>HNO₃</u>	<u>Dissolved Metals, Hardness, incl. Hg</u>
<u>00152</u>	<u>" "</u>	<u>No</u>		<u>TDS TSS SO₄</u>

Site Sketch:



ESA CONSULTANTS INC.

SURFACE WATER SAMPLING FORM

Station ID: DR-9-SW Project Name: RicoLocation: Santa Cruz Wetland drainage (east) to Dolores RiverDate: 10/23/96 Time: 1145 Gage Height: NAWeather Conditions: Clear, sl. windy, ~55°FSampling Personnel (Signature): [Signature]

FIELD MEASUREMENTS

pH/Temp: 6.93 / 7.7Elev. 8670 ft
Dissolved Oxygen (mg/L): 3.2 @ 7.0°C (field)
DO Correction = $3.2 * 0.72 = 2.3$ mg/L
Calculated Streamflow (cfs): 0.15Alkalinity (mg/L as CaCO₃): 264Specific Conductance/Temp. (μS): 480 / 6.8°CFe (II)(mg/L): .25 Fe (total)(mg/L): .40COMMENTS: Clear water, no staining in channel

WATER QUALITY SAMPLES

Tag No.	Date/Time	Filtered	Preserved	Analysis
<u>00145</u>	<u>10/23/96 1150</u>	<u>yes</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00146</u>	<u>" "</u>	<u>No</u>	<u>—</u>	<u>TDS, TSS, SO₄</u>

Site Sketch:



ESA CONSULTANTS INC.

SURFACE WATER SAMPLING FORM

Station ID: DR-16-SW Project Name: Rico
Location: Rico Boy Adit 20' down from origin
Date: 10/23/96 Time: 2:00 Gage Height: NA
Weather Conditions: Partly Cloudy, sl. breeze ~ 50°F
Sampling Personnel (Signature): J. Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.26 / 13.5 Dissolved Oxygen (mg/L): 7.6 @ 13.0°C (field)
Elev. 8685
DO Correction $7.6 * 0.72 = 5.5$ mg/L
Alkalinity (mg/L as CaCO₃): 685 Calculated Streamflow (cfs): 0.009
Specific Conductance/Temp. (μS): 1198 / 12.9
Fe (II)(mg/L): .05 Fe (total)(mg/L): .14

COMMENTS: Orange sediment in channel, abundant algae

WATER QUALITY SAMPLES

Tag No.	Date/Time	Filtered	Preserved	Analysis
<u>00147</u>	<u>10/23/96 2:15</u>	<u>yes</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness (Blank)</u>
<u>00148</u>	<u>" "</u>	<u>No</u>	<u>—</u>	<u>TDS TSS SO₄ (Blank)</u>
<u>00149</u>	<u>" "</u>	<u>yes</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00150</u>	<u>" "</u>	<u>No</u>	<u>—</u>	<u>TDS TSS SO₄</u>

Site Sketch:



ESA CONSULTANTS INC.

SURFACE WATER SAMPLING FORM

Station ID: DR-18-SW Project Name: RICO

Location: Dolores River @ old Bridge Abutment

Date: 10/24/96 Time: 1000 Gage Height: NA

Weather Conditions: Clear, Calm, ~ 40°F

Sampling Personnel (Signature): J. Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.59 / 0.1°C Elev = 8635 ft
Dissolved Oxygen (mg/L): 14 @ 0°C (field)
DO Correction = $14 \times 0.72 = 10.1 \text{ mg/L}$
Alkalinity (mg/L as CaCO₃): 120 Calculated Streamflow (cfs): 35.15

Specific Conductance/Temp. (μS): 168 / 0.2°C

Fe (II)(mg/L): 0.14 Fe (total)(mg/L): 0.15

COMMENTS: Sampled from East bank

WATER QUALITY SAMPLES

Tag No.	Date/Time	Filtered	Preserved	Analysis
<u>00158</u>	<u>10/24/96 10:15</u>	<u>yes</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00159</u>	<u>" "</u>	<u>No</u>	<u>—</u>	<u>TDS, TSS, SO₄</u>

Site Sketch:

**ESA CONSULTANTS INC.**

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(970) 484-3611 (970) 484-4118 FAX

SURFACE WATER SAMPLING FORMStation ID: SVS-8 Project Name: RICO Post VCUPLocation: 10 ft downstream of culvert in silver crkDate: 1-21-97 Time: 1415Weather Conditions: light snow ~ 25°F, 1.5 ft fresh snowSampling Personnel (Signature): Sarah Sullivan**FIELD MEASUREMENTS**pH/Temp: 8.85 / 0.0°C Dissolved Oxygen/Temp (mg/L): 10.9 / 0.0°C
DO correction = $10.9 + 0.71 = 7.7 \text{ mg/L}$ Specific Conductance/Temp ($\mu\text{S/cm}$): 190 / 0.4°CFe (II) (mg/L): 0.00 Fe (total)(mg/L): 0.00Alkalinity (mg/L as CaCO_3): 115 Calculated Streamflow (cfs): Not Measured
- iced up -COMMENTS: Ice on channel edge**WATER QUALITY SAMPLES**

Tag No.	Date/Time	Preserved	Analysis
<u>00166</u>	<u>1-21-97/1415</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00167</u>	<u>" "</u>	<u>"</u>	<u>TDS, TSS, SULFATE</u>

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SURFACE WATER SAMPLING FORM

Station ID: SVS-11 Project Name: RICO Post VCUP

Location: Seep Flow above confluence w/ Silver Creek

Date: 1-21-97 Time: 1345

Weather Conditions: Snowing lightly ~25°F, 1.5' fresh snow

Sampling Personnel (Signature): Jacob Sullivan

FIELD MEASUREMENTS

pH/Temp: 8.33/.05°C Dissolved Oxygen/Temp (mg/L): 9.8/0.0°C (field)
Elev 9130 ft
DO Correction 9.8 - 0.71 = 9.09 mg/L
Specific Conductance/Temp (μ S/cm): 390/0.4°C

Fe (II) (mg/L): 0.10 Fe (total)(mg/L): 0.45

Alkalinity (mg/L as CaCO₃): 110 Calculated Streamflow (cfs): Not Measured
-iced up-

COMMENTS: Fe Oxide deposits on rocks in channel

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00164</u>	<u>1-21-97/1345</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00165</u>	<u>" "</u>	<u>"</u>	<u>TDS, TSS, SULFATE</u>

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SURFACE WATER SAMPLING FORM

Station ID: SVS-12 Project Name: RICO Post VCUP

Location: Argentine tailings seep - 5' from origin

Date: 1-21-97 Time: 1045

Weather Conditions: snowing lightly ~ 25°F 1.5' fresh snow

Sampling Personnel (Signature): Sally Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.58 / 3.2°C Dissolved Oxygen/Temp (mg/L): 8.6 / 1.0°C
Elev 9170 ft
Do correction: $8.6 \times 0.71 = 6.1 \text{ mg/L}$
Specific Conductance/Temp ($\mu\text{S/cm}$): 493 / 3.0°C

Fe (II) (mg/L): 9.0 Fe (total)(mg/L): 10.3

Alkalinity (mg/L as CaCO_3): 130 Calculated Streamflow (cfs): 0.12

COMMENTS: Fe oxide deposits in channel

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00162</u>	<u>1-21-97 / 1045</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00163</u>	<u>" "</u>	<u>"</u>	<u>TDS, TSS, SULFATE</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-1-SW Project Name: RICO Post VCUP
Location: Columbia Tailings Side Channel - 40 ft up from Dolores R. Confluence
Date: 1-22-97 Time: 1430
Weather Conditions: ~30°F, Calm, 2-4 ft of snow on ground
Sampling Personnel (Signature): Sally Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.04 / 1.8°C Dissolved Oxygen/Temp (mg/L): 13.0 mg/L @ 3.0°C (field)
Elev 8,620 ft
DO correction = 13.0 * 0.72 = 9.4 mg/L
Specific Conductance/Temp (μ S/cm): 283 / 2.1°C
Fe (II) (mg/L): 4.6 Fe (total) (mg/L): 5.0
Alkalinity (mg/L as CaCO_3): 177 Calculated Streamflow (cfs): 0.25
COMMENTS: Fe oxide on rocks in channel

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00178</u>	<u>JAN. 22, 97 / 1430</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00179</u>	<u>" "</u>	<u>"</u>	<u>TDS, TSS, SULFATE</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-2-SW Project Name: RICO Post VCUP

Location: Dolores River @ West Rico Bridge

Date: 1-23-97 Time: 10:30

Weather Conditions: light snow, 6" in past 12 hrs

Sampling Personnel (Signature): Jodie Sullivan

FIELD MEASUREMENTS

pH/Temp: 8.15/0.3°C Dissolved Oxygen/Temp (mg/L): 15.0 mg/L @ 0.5°C (field)
Elev. 8700 ft
DO Correction = $15.0 \times 0.72 = 10.8 \text{ mg/L}$

Specific Conductance/Temp ($\mu\text{S/cm}$): 219 / 0.3°C

Fe (II) (mg/L): 0.05 Fe (total) (mg/L): 0.09

Alkalinity (mg/L as CaCO_3): 112 Calculated Streamflow (cfs): Not Measured - Ice

COMMENTS: Extensive ice on channel's edge

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00184</u>	<u>1-23-97/1030</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00185</u>	<u>" "</u>	<u>"</u>	<u>TDS, TSS, SULFATE</u>
<u>00186</u>	<u>" "</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness (DUPE)</u>
<u>00187</u>	<u>" "</u>	<u>"</u>	<u>TDS, TSS, SULFATE (DUPE)</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-4-SW Project Name: RICO Post VCUP

Location: Dolores River @ Cemetery

Date: 1-23-97 Time: 0900

Weather Conditions: Snowing Lightly, 6" of snow past 12 hrs

Sampling Personnel (Signature): Jedid Sullivan

FIELD MEASUREMENTS

pH/Temp: 8.32 / 1.1°C Dissolved Oxygen/Temp (mg/L): 13.8 @ 1.0°C (field)
Elev 8,600 ft
DO Correction: 13.8 * 0.72 = 9.9 mg/L
Specific Conductance/Temp (μ S/cm): 235 / 1.4°C

Fe (II) (mg/L): 0.12 Fe (total)(mg/L): 0.17

Alkalinity (mg/L as CaCO_3): 147 Calculated Streamflow (cfs): None Measured - Ice

COMMENTS: Extensive ice on edge of channel

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00180</u>	<u>1-23-97/0900</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00181</u>	<u>" "</u>	<u>—</u>	<u>TDS, TSS, SULFATE</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-7-SW Project Name: RICO Post VCUP

Location: SILVER SWAN ADIT

Date: 1-22-97 Time: 1100

Weather Conditions: ~30°F Cloudy, calm 2-3 ft of snow on ground

Sampling Personnel (Signature): David Sullivan

FIELD MEASUREMENTS

pH/Temp: 6.48 / 7.5°C Dissolved Oxygen/Temp (mg/L): 7.8 mg/L @ 7.0°C (field)
Elev 8,675 ft
DO correction: 7.8 + 0.72 = 5.6 mg/L

Specific Conductance/Temp (μ S/cm): 7.31 / 6.0°C

Fe (II) (mg/L): 4.0 Fe (total)(mg/L): 6.8

Alkalinity (mg/L as CaCO₃): 496 Calculated Streamflow (cfs): Not Measured
non-channelized & backwater

COMMENTS: Collected samples @ soap source. attempted to measure flow @ culvert but not enough drop - culvert is sitting in (2") due to backwater

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00174</u>	<u>1-22-97 / 1100</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00175</u>	<u>" "</u>	<u>"</u>	<u>TDS, TSS, SULFATE</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-8-SW Project Name: RICO Post VCUP

Location: Santa Cruz Adit

Date: 1-22-97 Time: 0940

Weather Conditions: ~30°F No snow past 12 hrs 2 to 3 ft of snow on ground

Sampling Personnel (Signature): Jodi O'Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.67 / 6.3°C Dissolved Oxygen/Temp (mg/L): 9.5 mg/L @ 4.0°C (field)
Elev 8690 ft
DO Correction: 9.5 * 0.72 = 6.8 mg/L
Specific Conductance/Temp (μS/cm): 929 / 6.0°C

Fe (II) (mg/L): .02 mg/L Fe (total)(mg/L): .14

Alkalinity (mg/L as CaCO₃): 750 Calculated Streamflow (cfs): 0.033

COMMENTS: Sampled & measured discharge @ adit opening
Fe oxide & algae in channel

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00170</u>	<u>1-22-97/0940</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00171</u>	<u>" "</u>	<u>—</u>	<u>TDS, TSS, SULFATE</u>
<u>00172</u>	<u>" "</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness (Filter blank)</u>
<u>00173</u>	<u>" "</u>	<u>—</u>	<u>TDS, TSS, SULFATE (Bottle blank)</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-9-SW Project Name: RICO Post VCUP

Location: SANTA CRUZ WETLANDS DISCHARGE

Date: 1-22-97 Time: 1220

Weather Conditions: ~25°F, CALM, 2 to 4 feet of snow on ground

Sampling Personnel (Signature): David Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.93/1.8°C Elev. 8670 ft
Dissolved Oxygen/Temp (mg/L): 11.2 mg/L @ 5.0°C (field)
DO correction: 11.2 * 0.72 = 8.1 mg/L
Specific Conductance/Temp (μ S/cm): 397 / 2.0°C

Fe (II) (mg/L): 0.30 Fe (total)(mg/L): 0.48

Alkalinity (mg/L as CaCO_3): 276 Calculated Streamflow (cfs): Not measured
- non channelized -

COMMENTS: Collected sample 8' upstream from Dolores Confluence
Flow isn't channelized but is flowing into river from broad area
under snowbanks,

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00176</u>	<u>1-22-97/1220</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00177</u>	<u>" "</u>	<u>"</u>	<u>TDS, TSS, SULFATE</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-16-SW1 Project Name: RICO Post VCUP

Location: Rico Boy Adit

Date: 1-22-97 Time: 0918

Weather Conditions: ~30°F No snow past 12 hrs - 2 to 3 feet of snow on ground

Sampling Personnel (Signature): Sarah Sullivan

FIELD MEASUREMENTS

pH/Temp: 8.31 / 3.5°C Dissolved Oxygen/Temp (mg/L): 11.7 @ 5.0°C (field)
Elev 8685 ft
DO Correction: $11.7 + 0.72 = 8.4 \text{ mg/L}$

Specific Conductance/Temp ($\mu\text{S/cm}$): 439 / 4.0°C

Fe (II) (mg/L): 0.10 Fe (total) (mg/L): 0.10

Alkalinity (mg/L as CaCO_3): 675 Calculated Streamflow (cfs): 0.008

COMMENTS: Sampled & measured discharge @ culvert outfall
Fe oxide & abundant algae in channel

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00168</u>	<u>1-22-97/0918</u>	<u>HNO_3</u>	<u>Diss Metals, Hardness</u>
<u>00169</u>	<u>" "</u>	<u>—</u>	<u>TDS, TSS, SULFATE</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-18-SW Project Name: RICO Post VCUP
Location: Dolores River near old bridge abutment
Date: 1-23-97 Time: 0925
Weather Conditions: Snowing lightly, 6" in past 12 hrs
Sampling Personnel (Signature): David Sullivan

FIELD MEASUREMENTS

pH/Temp: 8.98 / 0.4°C Dissolved Oxygen/Temp (mg/L): 14.8 mg/L @ 0.4°C (field)
Elev. 8635ft
DO correction: 14.8 x 0.92 = 10.7 mg/L
Specific Conductance/Temp (μ S/cm): 219 / 0.5°C
Fe (II) (mg/L): 0.16 Fe (total)(mg/L): 0.16
Alkalinity (mg/L as CaCO_3): 128 Calculated Streamflow (cfs): Not Measured - ice
COMMENTS: Ice on channel edge

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00182</u>	<u>1-23-97/0925</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00183</u>	<u>" "</u>	<u>" "</u>	<u>TDS, TSS, SULFATE</u>

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SURFACE WATER SAMPLING FORM

Station ID: SVS-5 Project Name: RICO Post VCUP
Location: Upstream of culvert above Argentine Tailings - Silver Crk
Date: 4-16-97 Time: 1120
Weather Conditions: Clear, Calm, ~ 50°F
Sampling Personnel (Signature): Jacob Sullivan

FIELD MEASUREMENTS

pH/Temp: 8.44 / 1.8°C Dissolved Oxygen/Temp (mg/L): 14.0 mg/L @ 2.2°C
DO (Correction) = 14.0 * 0.70 = 9.8 mg/L
Specific Conductance/Temp (µS/cm): 119 @ 1.9°C
Fe (II) (mg/L): 0.01 Fe (total)(mg/L): 0.84
Alkalinity (mg/L as CaCO₃): 191 Calculated Streamflow (cfs): 2.33
COMMENTS: 2' snow banks on channel's edge

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00188</u>	<u>4/16/97 1130</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00189</u>	<u>" "</u>	<u>" "</u>	<u>TDS, TSS, SULFATE</u>

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SURFACE WATER SAMPLING FORMStation ID: SVS-8 Project Name: RICO Post VCUPLocation: Silver Creek below culvertDate: 4/16/97 Time: 1438Weather Conditions: partly cloudy 40°F Snow conesSampling Personnel (Signature): Jacob Sullivan**FIELD MEASUREMENTS**

pH/Temp: 7.17 / 15.2°C Dissolved Oxygen/Temp (mg/L): 13.5 mg/L @ 5.0°C
Elev 9120 ft
75. DO Correction: $13.5 + 0.71 = 9.6 \text{ mg/L}$

Specific Conductance/Temp ($\mu\text{S/cm}$): 434 196 @ 5.0°CFe (II) (mg/L): 0.07 Fe (total) (mg/L): 0.08Alkalinity (mg/L as CaCO_3): 86 Calculated Streamflow (cfs): 2.27COMMENTS: Clear water**WATER QUALITY SAMPLES**

Tag No.	Date/Time	Preserved	Analysis
<u>00194</u>	<u>4/16/97 1500</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00195</u>	<u>" "</u>		<u>TDS, TSS, SULFATE</u>

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SURFACE WATER SAMPLING FORM

Station ID: SUS-11 Project Name: RICO Post VCUP

Location: Argentine Soap flow 20 ft above confluence

Date: 4/16/97 Time: 1330

Weather Conditions: Clear, Calm ~ 45°F

Sampling Personnel (Signature): Jared Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.61 / 9.6°C Dissolved Oxygen/Temp (mg/L): 11.2 mg/L @ 9.0°C
Elev 9130 ft
DO Correction = $11.2 \times 0.71 = 8.0 \text{ mg/L}$
Specific Conductance/Temp ($\mu\text{S/cm}$): 810 @ 9.1°C

Fe (II) (mg/L): 1.92 Fe (total)(mg/L): 3.82

Alkalinity (mg/L as CaCO_3): 127 Calculated Streamflow (cfs): non-channelized
not measurable

COMMENTS: Fe staining in channel - heavy

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00192</u>	<u>4/16/97 1400</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00193</u>	<u>" "</u>	<u>"</u>	<u>TDS, TSS, SULFATE</u>

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SURFACE WATER SAMPLING FORM

Station ID: SVS-12 Project Name: RICO Post VCUP

Location: Argentine Tailings Seep - 10 ft down from source

Date: 4-16-97 Time: 1230

Weather Conditions: Clear, Calm ~ 50°F Snow Cover

Sampling Personnel (Signature): David Sullivan

FIELD MEASUREMENTS

pH/Temp: 6.72 / 10.5 Dissolved Oxygen/Temp (mg/L): 8.3 mg/L @ 4.1°C
Elev 9170 ft.
DO Correction: 8.3 + 0.71 = 9.01 mg/L
Specific Conductance/Temp (μ S/cm): 807 @ 9.7°C

Fe (II) (mg/L): 10.8 Fe (total) (mg/L): 11.8

Alkalinity (mg/L as CaCO_3): 150 Calculated Streamflow (cfs): 0.11
Flume 1st: 0.24

COMMENTS: Flume Reading 0.24 ft - red rust in channel

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00190</u>	<u>4/16/97 1250</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00191</u>	<u>" "</u>	<u>" "</u>	<u>TDS, TSS, SULFATE</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-1-SW Project Name: RICO Post VCUP

Location: DELORRES RIVER East channel 20 ft above confluence w/ Main Stem

Date: 4-17-97 Time: 0830

Weather Conditions: Clear, Calm \approx 30°F Patchy Snow cover

Sampling Personnel (Signature): Jacob Sullivan

FIELD MEASUREMENTS

pH/Temp: 6.22 / 3.1°C Dissolved Oxygen/Temp (mg/L): 11.4 mg/L @ 4.0°C (field)
Elev 8,680 ft
DO Correction = $11.4 \times 0.72 = 8.2$ mg/L

Specific Conductance/Temp (μ S/cm): 385 @ 3.7°C

Fe (II) (mg/L): 5.2 Fe (total)(mg/L): 13.5

Alkalinity (mg/L as CaCO₃): 125 Calculated Streamflow (cfs): 0.137

COMMENTS: Heavy Iron precipitation in channel

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00202</u>	<u>4-17-97 0900</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00203</u>	<u>" "</u>	<u>" "</u>	<u>TDS, TSS, SULFATE</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-2-SW Project Name: RICO POST VCUP

Location: DOLORES RIVER @ West Rico Bridge

Date: 4/18/97 Time: 1200

Weather Conditions: partly cloudy, slight breeze ~ 50°F

Sampling Personnel (Signature): Jodd Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.03 / 5.7°C Dissolved Oxygen/Temp (mg/L): 12.2 mg/L
Elev 8,700 ft
DO Correction = $12.2 \times 0.72 = 8.8 \text{ mg/L}$
Specific Conductance/Temp ($\mu\text{S/cm}$): 195 @ 6.1°C

Fe (II) (mg/L): 0.02 Fe (total)(mg/L): 0.14

Alkalinity (mg/L as CaCO_3): 122 Calculated Streamflow (cfs): 73.7

COMMENTS: Moderate Flow, slightly turbid, patchy snow

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00218</u>	<u>4/18/97 1220</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00219</u>	<u>" "</u>	<u>---</u>	<u>TDS, TSS, Sulfate</u>
<u>00220</u>	<u>" "</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00221</u>	<u>" "</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00222</u>	<u>" "</u>	<u>---</u>	<u>TDS, TSS, Sulfate</u>

Site Sketch:
Comments:

- * Tag# 00220 is a filter blank testing peristaltic pump filtering apparatus
- * Tag# 00221 is a filter blank testing hand pump filtering apparatus
- * Tag# 00222 is a bottle blank.



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SURFACE WATER SAMPLING FORM

Station ID: DR-4-SW Project Name: RICO POST VCUP
Location: DOLORES RIVER NEAR CEMETERY
Date: 4/18/97 Time: 0800
Weather Conditions: Clear, Calm, ~ 25°F Patchy Snow
Sampling Personnel (Signature): Jodd Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.04 / 3.1°C Dissolved Oxygen/Temp (mg/L): 13.5 mg/L
^{Elev 8,000 ft}
DO Correction $13.5 \times 0.72 = 9.7 \text{ mg/L}$
Specific Conductance/Temp ($\mu\text{S/cm}$): 191 @ 3.1°C
Fe (II) (mg/L): 0.08 Fe (total)(mg/L): 0.19
Alkalinity (mg/L as CaCO_3): 100 Calculated Streamflow (cfs): 70.3
COMMENTS: Moderate Flow, slightly turbid

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00214</u>	<u>4/18/97 0900</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00215</u>	<u>" "</u>	<u>---</u>	<u>TDS, TSS, Sulfate</u>
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SURFACE WATER SAMPLING FORMStation ID: DR-6-SW Project Name: RICO Post VCUPLocation: Silver Swan Wetland DischargeDate: 4/17/97 Time: 1300Weather Conditions: partly cloudy, warmSampling Personnel (Signature): Jodie Sullivan**FIELD MEASUREMENTS**pH/Temp: 7.04 / 11.9°C Dissolved Oxygen/Temp (mg/L): 12.0 mg/L @ 12°C
Elev 8670 ft
DO Correction $12.0 \pm 0.72 = 8.6 \text{ mg/L}$ Specific Conductance/Temp ($\mu\text{S/cm}$): 262 @ 12.5°CFe (II) (mg/L): 0.03 Fe (total)(mg/L): 0.16Alkalinity (mg/L as CaCO_3): 135 Calculated Streamflow (cfs): 0.57COMMENTS: Moderate flow, clear, little Fe-precip.**WATER QUALITY SAMPLES**

Tag No.	Date/Time	Preserved	Analysis
<u>00208</u>	<u>4/17/97 1320</u>	<u>HNO₃</u>	<u>Diss Metals, Hardness</u>
<u>00209</u>	<u>" "</u>	<u>" "</u>	<u>TDS, TSS, SULFATE</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-7-SW Project Name: RICO POST VCUP

Location: Silver Swan adit @ seep source

Date: 4/17/97 Time: 1425

Weather Conditions: Partly Cloudy, Warm

Sampling Personnel (Signature): Jodd Sullivan

FIELD MEASUREMENTS

pH/Temp: 5.90 / 11.4°C Elevation 8675 ft
Dissolved Oxygen/Temp (mg/L): 4.3 mg/L @ 12°C
DO Correction: $4.3 + 0.72 = 3.1$ mg/L
Specific Conductance/Temp (µS/cm): 724 @ 11.9°C

Fe (II) (mg/L): 2.3 Fe (total)(mg/L): 2.5

Alkalinity (mg/L as CaCO₃): 420 Calculated Streamflow (cfs): Not Measured
Non channelized & backwater

COMMENTS: Very heavy Fe - precip. source is mainly
4' up hill but there is some upwelling flow in pool

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00212</u>	<u>4/17/97 1425</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00213</u>	<u>" "</u>	<u>---</u>	<u>TDS, TSS, Sulfate</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-8-SW Project Name: RICO POST VCUP

Location: Santa Cruz adit

Date: 4/16/97 Time: 1800

Weather Conditions: Overcast slight breeze ~ 30°F Snow cones

Sampling Personnel (Signature): Jodd Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.17/15.0°C Dissolved Oxygen/Temp (mg/L): 6.2 mg/L @ 14.8°C
Elev 8640 ft
DO Correction: $6.2 \times 0.72 = 4.5 \text{ mg/L}$
Specific Conductance/Temp ($\mu\text{S/cm}$): 1131 @ 15.0°C

Fe (II) (mg/L): 0.01 Fe (total) (mg/L): 0.20

Alkalinity (mg/L as CaCO_3): 645 Calculated Streamflow (cfs): 0.051

COMMENTS: algae in channel

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00198</u>	<u>4/16/97 1810</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00199</u>	<u>" "</u>	<u>—</u>	<u>TDS, TSS, Sulfate</u>
<u>00200</u>	<u>" "</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00201</u>	<u>" "</u>	<u>—</u>	<u>TDS, TSS, Sulfate</u> } <u>Dupes</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-9-SW Project Name: RICO Post VCUP

Location: Santa Cruz Wetland Discharge East

Date: 4/17/97 Time: 1100

Weather Conditions: Partly Cloudy, $\approx 50^{\circ}\text{F}$

Sampling Personnel (Signature): Sally Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.26/6.8 $^{\circ}\text{C}$ Dissolved Oxygen/Temp (mg/L): 12.2 mg/L @ 7.5 $^{\circ}\text{C}$
Elev. 8670 ft
DO Correction: 12.2 + 0.72 = 8.8 mg/L
Specific Conductance/Temp ($\mu\text{S}/\text{cm}$): 329 @ 6.7 $^{\circ}\text{C}$

Fe (II) (mg/L): 0.09 Fe (total)(mg/L): 0.33

Alkalinity (mg/L as CaCO_3): 175 Calculated Streamflow (cfs): 0.57

COMMENTS: low flow, clear

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00204</u>	<u>4/17/97 1120</u>	<u>HNO_3</u>	<u>Diss. Metals, Hardness</u>
<u>00205</u>	<u>" "</u>	<u></u>	<u>TDS, TSS, SULFATE</u>
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SURFACE WATER SAMPLING FORMStation ID: DR-10-SWProject Name: RICO Post VCUPLocation: Santa Cruz Wetland discharge - westDate: 4/17/97Time: 1130Weather Conditions: Partly Cloudy, $\approx 50^{\circ}\text{F}$ Sampling Personnel (Signature): John Sullivan**FIELD MEASUREMENTS**pH/Temp: 7.33 / 12.3°C Elev 8460 ft
Dissolved Oxygen/Temp (mg/L): 11.3 mg/L @ 13.0°C
DO correction $11.3 \times 0.72 = 8.1 \text{ mg/L}$ Specific Conductance/Temp ($\mu\text{S/cm}$): 1002 @ 12.0°C Fe (II) (mg/L): 0.03Fe (total)(mg/L): 0.04Alkalinity (mg/L as CaCO_3): 530Calculated Streamflow (cfs): Not measured
- over land flow -COMMENTS: low flow, non-channelized**WATER QUALITY SAMPLES**

Tag No.	Date/Time	Preserved	Analysis
<u>00206</u>	<u>4/17/97 1140</u>	<u>HNO_3</u>	<u>Diss. Metals, Hardness</u>
<u>00207</u>	<u>" "</u>	<u>"</u>	<u>TDS, TSS, SULFATE</u>

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SURFACE WATER SAMPLING FORMStation ID: DR-15a-SWProject Name: RICO Post VCUPLocation: Sulphur Creek 15' upstream of discharge to Silver Swan WetlandDate: 4/17/97 Time: 1330Weather Conditions: partly cloudy, warm, slight windSampling Personnel (Signature): Sadie Sullivan**FIELD MEASUREMENTS**

pH/Temp: 8.06 / 6.7°C Dissolved Oxygen/Temp (mg/L): 13.4 mg/L @ 7.0°C
DO Correction: 13.4 + 0.72 = 14.12 mg/L
Specific Conductance/Temp (μ S/cm): 96.7 @ 6.8°C

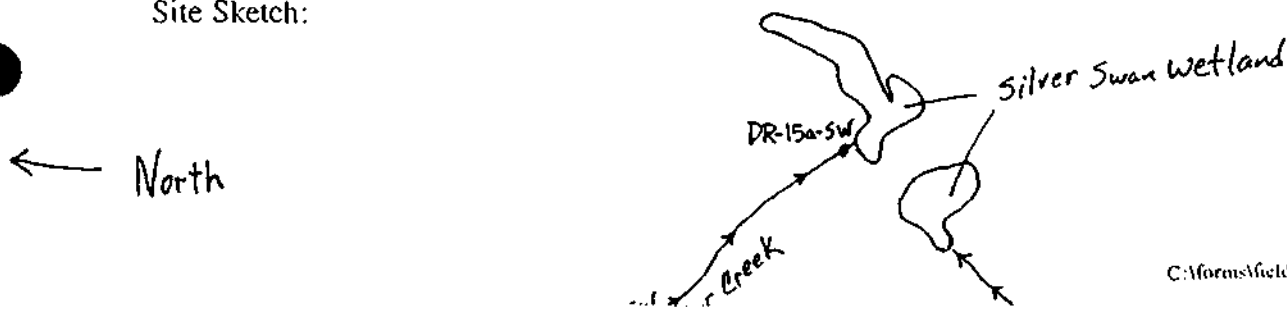
Fe (II) (mg/L): 0.05 Fe (total) (mg/L): 0.00Alkalinity (mg/L as CaCO_3): 52.0 Calculated Streamflow (cfs): 0.003

COMMENTS: Moderate flow - clear
Sampled 10 ft upstream from discharge into wetland

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00210</u>	<u>4/17/97 1340</u>	<u>HNO₃</u>	<u>Diss. Metals, Hardness</u>
<u>00211</u>	<u>" "</u>	<u>" "</u>	<u>TDS, TSS, SULFATE</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-16-SW Project Name: RICO POST VCUP

Location: Rico Bay Adit

Date: 4/16/97 Time: 1720

Weather Conditions: Overcast - Light snow ~ 30°F

Sampling Personnel (Signature): Judd Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.42/11.8°C Dissolved Oxygen/Temp (mg/L): 9.2 mg/L @ 12.0°C
Elev 8685 ft
DO Correction 9.2 + 0.72 = 6.6 mg/L
Specific Conductance/Temp (µS/cm): 1060 @ 11.6°C

Fe (II) (mg/L): 0.04 Fe (total)(mg/L): 0.23

Alkalinity (mg/L as CaCO₃): 460 Calculated Streamflow (cfs): 0.015

COMMENTS: abundant algae in channel

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00196</u>	<u>4/16/97 1730</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00197</u>	<u>" "</u>	<u>—</u>	<u>TDS, TSS, Sulfate</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-18-SW Project Name: RICO POST VCUP
Location: DOLORES RIVER at Old Bridge abutment
Date: 4/18/97 Time: 1030
Weather Conditions: Clear, Calm, ~ 40°F, patchy snow
Sampling Personnel (Signature): Todd Sullivan

FIELD MEASUREMENTS

pH/Temp: 6.92 / 5.9°C Dissolved Oxygen/Temp (mg/L): 12.6 mg/L
^{Elev 8635 ft}
DO Correction $12.6 + 0.72 = 9.1 \text{ mg/L}$
Specific Conductance/Temp ($\mu\text{S/cm}$): 200 @ 5.9°C
Fe (II) (mg/L): 0.07 Fe (total) (mg/L): 0.19
Alkalinity (mg/L as CaCO_3): 88 Calculated Streamflow (cfs): 66.8
COMMENTS: Moderate flow, slightly turbid

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00216</u>	<u>4/18/97 1045</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00217</u>	<u>" "</u>	<u>—</u>	<u>TDS, TSS, Sulfate</u>

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SURFACE WATER SAMPLING FORM

Station ID: SNS-5

Project Name: RICO POST VCUP

Location: SILVER CREEK - 50 ft above Culvert near Mill

Date: 7/29/97

Time: 1000

Weather Conditions: Overcast, 60°F Heavy Rain Past 72 Hrs.

Sampling Personnel (Signature): Todd Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.55 / 8.0°F Dissolved Oxygen/Temp (mg/L): 8.6
Elevation Correction Factor 0.70

Specific Conductance/Temp (μ S/cm): 111.6 @ 8.4°C

Fe (II) (mg/L): 0.18 Fe (total)(mg/L): 1.39

Alkalinity (mg/L as CaCO₃): 69 Calculated Streamflow (cfs): 5.68

COMMENTS: Very heavy Fe-stain on rocks in channel, water is clean to slightly murky.

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00221</u>	<u>7/29/97 1030</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00222</u>	<u>7/29/97 1030</u>	<u>—</u>	<u>TDS, TSS, Sulfate</u>

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SURFACE WATER SAMPLING FORM

Station ID: SVS-8 Project Name: RICO POST VCUP

Location: SILVER CREEK BELOW ARGENTINE SEEP CONFLUENCE

Date: 7-29-97 Time: 1220

Weather Conditions: OVERCAST ~ 70°F

Sampling Personnel (Signature): Judd Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.46 10.1°C Dissolved Oxygen/Temp (mg/L): 8.4
Elevation Correction factor 0.71

Specific Conductance/Temp ($\mu\text{S}/\text{cm}$): 169 10.3°C

Fe (II) (mg/L): 0.02 Fe (total)(mg/L): 1.16

Alkalinity (mg/L as CaCO_3): 70 Calculated Streamflow (cfs): 6.05

COMMENTS: WATER IS MURKY, ROCKS ARE FE-STAINED, Sampled 10 FT BELOW CULVERT

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00223</u>	<u>7-29-97 1222</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00224</u>	<u>" "</u>	<u>—</u>	<u>TDS, TSS, Sulfate</u>
<u>00225</u>	<u>" "</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness (Dupe)</u>
<u>00226</u>	<u>" "</u>	<u>—</u>	<u>TDS, TSS, Sulfate (Dupe)</u>

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SURFACE WATER SAMPLING FORM

Station ID: SVS-11

Project Name: RICO POST VCUP

Location: Argentine Tailings seep 3' above confluence w/ Silver CRK.

Date: 7-29-97

Time: 1355

Weather Conditions: Overcast, slight breeze, ~60°F

Sampling Personnel (Signature): Jodd Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.34 16.0

Dissolved Oxygen/Temp (mg/L): 4.7
Elevation Correction factor 0.71

Specific Conductance/Temp (μ S/cm): 1055 15.9°C

Fe (II) (mg/L): 3.02

Fe (total)(mg/L): 4.41

Alkalinity (mg/L as CaCO_3): 133

Calculated Streamflow (cfs): 0.11 estimated

COMMENTS: Munky water - very heavy Fe-stain on rocks, non channelized

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00227</u>	<u>7-29-97 1355</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00228</u>	<u>" "</u>	<u>---</u>	<u>TDS, TSS, Sulfate</u>
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SURFACE WATER SAMPLING FORM

Station ID: SUS-12

Project Name: RICO POST VCUP

Location: Argentine Tailings Soap, middle soap of 3, 5 ft down from source

Date: 7-29-97

Time: 1510

Weather Conditions: Overcast, Very light rain, ~65°F

Sampling Personnel (Signature): Judd Sullivan

FIELD MEASUREMENTS

pH/Temp: 6.46 8.5

Dissolved Oxygen/Temp (mg/L): 6.5

Elevation Correction Factor 0.71

Specific Conductance/Temp ($\mu\text{S}/\text{cm}$): 822 9.4

Fe (II) (mg/L): 7.0

Fe (total)(mg/L): 12.6

Alkalinity (mg/L as CaCO_3): 138

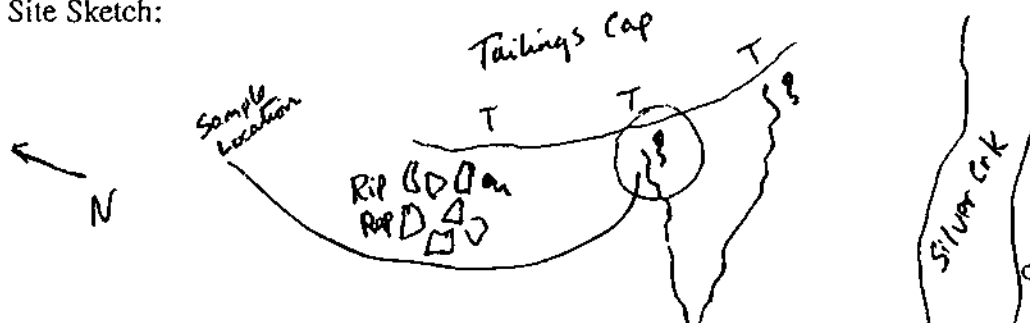
Calculated Streamflow (cfs): 0.13

COMMENTS: v. low flow, Fe-stain on rocks in channel - more staining the further downstream. Recent unstained sediment has washed into channel, covering Fe-stain.

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00229</u>	<u>7-29-97 1510</u>	<u>HNO₃</u>	<u>Dissolved Metals, Hardness</u>
<u>00230</u>	<u>" "</u>	<u>—</u>	<u>TDS, TSS, Sulfate</u>
<u>00231</u>	<u>" "</u>	<u>NaOH</u>	<u>Cyanide</u>
<u>00232</u>	<u>" "</u>	<u>NaOH</u>	<u>Cyanide (Dupe)</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-1-SW Project Name: RICO POST VCUP

Location: Dolores River East Channel below Columbia Tailings

Date: 7-30-97 Time: 1545

Weather Conditions: Overcast, just stopped raining, Light rain past 22 Hrs

Sampling Personnel (Signature): Todd Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.20 10.5°C Dissolved Oxygen/Temp (mg/L): 8.5
Elevation Correction Factor 0.72

Specific Conductance/Temp (μ S/cm): 98.6 10.6°C

Fe (II) (mg/L): 0.15 Fe (total)(mg/L): 1.24

Alkalinity (mg/L as CaCO_3): 44 Calculated Streamflow (cfs): 77.6

COMMENTS: Sampled ~ 20 ft above confluence

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00245</u>	<u>7/30/97 1550</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00246</u>	<u>" "</u>	<u>---</u>	<u>TDS, TSS, Sulfate</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-2-SW Project Name: RICO POST VCUP

Location: DOLORS RIVER @ West Rico Bridge

Date: 7-30-97 Time: 1240

Weather Conditions: light rain, overcast, raining past 18 hours

Sampling Personnel (Signature): Judd Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.33 @ 10°C Dissolved Oxygen/Temp (mg/L): 8.4
Elevation correction factor 0.72

Specific Conductance/Temp (μ S/cm): 111.3 @ 10.1°C

Fe (II) (mg/L): 0.02 Fe (total)(mg/L): 0.60

Alkalinity (mg/L as CaCO_3): 47 Calculated Streamflow (cfs): 262 EST. from USGS
Gaging Station

COMMENTS: Sampled from the NE bank under bridge

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00237</u>	<u>7/30/97 1300</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00238</u>	<u>" "</u>	<u>---</u>	<u>TDS, TSS, Sulfate</u>

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SURFACE WATER SAMPLING FORMStation ID: DR-4-SWProject Name: RICO POST VCUPLocation: Dolores River below CemeteryDate: 7-30-97 Time: 1500Weather Conditions: Overcast, heavy rain past 20 hoursSampling Personnel (Signature): Jodd Sullivan**FIELD MEASUREMENTS**pH/Temp: 6.88 @ 10.6°C Dissolved Oxygen/Temp (mg/L): 8.6
Elevation Correction factor 0.72Specific Conductance/Temp ($\mu\text{S}/\text{cm}$): 117 @ 10.8°CFe (II) (mg/L): 0.03 Fe (total)(mg/L): 1.73Alkalinity (mg/L as CaCO_3): 48 Calculated Streamflow (cfs): 262 Estimated from USGS gaging stationCOMMENTS: Very high flow, muddy water, sampled from east bank.**WATER QUALITY SAMPLES**

Tag No.	Date/Time	Preserved	Analysis
<u>00243</u>	<u>7/30/97 1515</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00244</u>	<u>" "</u>	<u>---</u>	<u>TDS, TSS, Sulfate</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-6-SW Project Name: RICO POST VCUP

Location: Silver Swan Wetland Discharge

Date: 7-31-97 Time: 1030

Weather Conditions: Partly Cloudy, no rain past 12 hours

Sampling Personnel (Signature): Todd Sullivan

FIELD MEASUREMENTS

pH/Temp: 6.26 @ 12.8°C Dissolved Oxygen/Temp (mg/L): 7.5
Elevation Correction Factor 0.72

Specific Conductance/Temp (μ S/cm): 202.7 @ 12.9°C

Fe (II) (mg/L): 0.13 Fe (total)(mg/L): 0.40

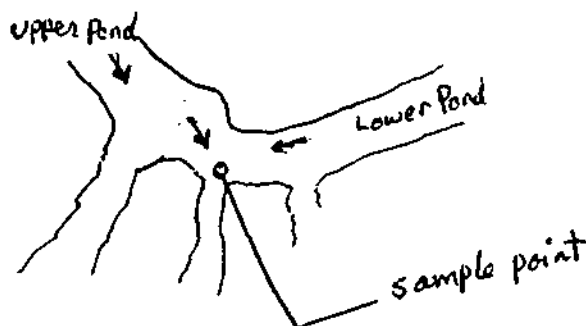
Alkalinity (mg/L as CaCO_3): 97 Calculated Streamflow (cfs): 1.07

COMMENTS: 3 channels discharging into the Dolores. Sampled 5'
above confluence where all flows coningled

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00249</u>	<u>7/31/97 1040</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00250</u>	<u>" "</u>	<u>---</u>	<u>TDS, TSS, Sulfate</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-7-SW

Project Name: RICO POST VCUP

Location: Silver Swan Adit

Date: 7-31-97

Time: 1130

Weather Conditions: Partly Cloudy, no rain past 12 hours

Sampling Personnel (Signature): Todd Sullivan

FIELD MEASUREMENTS

pH/Temp: 5.70 10.9°C

Dissolved Oxygen/Temp (mg/L): 4.3
Elevation correction factor 0.72

Specific Conductance/Temp (μ S/cm): 702 11.3°C

Fe (II) (mg/L): 3.09

Fe (total)(mg/L): 3.21

Alkalinity (mg/L as CaCO_3): 415

Calculated Streamflow (cfs): 0.30

COMMENTS: low flow, flow upwells from pool near source,
Fe-stain on rocks

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00253</u>	<u>7/31/97</u> <u>1130</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00254</u>	<u>"</u> <u>"</u>	<u>---</u>	<u>TDS, TSS, Sulfate</u>

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SURFACE WATER SAMPLING FORM

Station ID: DR-8-SW Project Name: RICO POST VCUP

Location: Santa Cruz Adit

Date: 7-30-97 Time: 1000

Weather Conditions: light rain past 14 hrs.

Sampling Personnel (Signature): Jodd Sullivan

FIELD MEASUREMENTS

pH/Temp: 6.28 @ 15.8°C Dissolved Oxygen/Temp (mg/L): 4.2
Elevation Correction factor 0.72

Specific Conductance/Temp (μ S/cm): 1103 @ 16.1°C

Fe (II) (mg/L): 0.00 Fe (total)(mg/L): 0.09

Alkalinity (mg/L as CaCO₃): 555 Calculated Streamflow (cfs): 0.06 Estimated

COMMENTS: Sampled @ gate

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00235</u>	<u>7/30/97 1030</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00236</u>	<u>" "</u>	<u>—</u>	<u>TDS, TSS, Sulfate</u>
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Site Sketch:



ESA CONSULTANTS INC.
2637 Midpoint Drive, Suite F
Fort Collins, Colorado 80525
(970) 484-3611 (970) 484-4118 FAX

SURFACE WATER SAMPLING FORM

Station ID: DR-10-SW Project Name: RICO POST VCUP

Location: Santa Cruz Wetland Discharge West

Date: 7/31/97 Time: 0900

Weather Conditions: Partly Cloudy, rained all day yesterday & 2 day prior

Sampling Personnel (Signature): Todd Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.00 14.2 Dissolved Oxygen/Temp (mg/L): 5.8
Estimated correction factor 0.72

Specific Conductance/Temp ($\mu\text{S}/\text{cm}$): 947 13.9°C

Fe (II) (mg/L): 0.00 Fe (total)(mg/L): 0.12

Alkalinity (mg/L as CaCO_3): 450 Calculated Streamflow (cfs): < 0.01

COMMENTS: Dolores River side channel commingles with this channel 150' above normal sample point. Sampled wetland channel just above confluence

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00247</u>	<u>7/31/97</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00248</u>	<u>"</u>	<u>—</u>	<u>TDS, TSS, Sulfate</u>

Site Sketch:



ESA CONSULTANTS INC.
2637 Midpoint Drive, Suite F
Fort Collins, Colorado 80525
(970) 484-3611 (970) 484-4118 FAX

SURFACE WATER SAMPLING FORM

Station ID: DR-15a-SW Project Name: RICO POST VCHP

Location: Sulphure Creek 10' above confluence w/ lower pond

Date: 7-31-97 Time: 1100

Weather Conditions: Partly cloudy, heavy precip yesterday

Sampling Personnel (Signature): Todd Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.69 11.4°C Dissolved Oxygen/Temp (mg/L): 7.7
Est. Elev. correction factor 0.72

Specific Conductance/Temp ($\mu\text{S}/\text{cm}$): 99.8 11.6°C

Fe (II) (mg/L): 0.00 Fe (total)(mg/L): 0.00

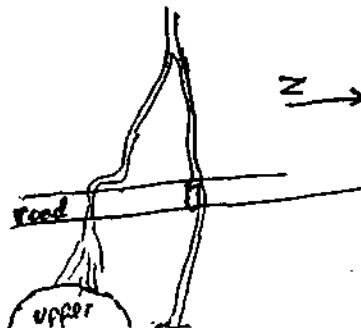
Alkalinity (mg/L as CaCO_3): 45 Calculated Streamflow (cfs): 0.66

COMMENTS: Channel splits ~ 60 FT above road, north channel goes to lower pond, Sampled north channel 10' above discharge to lower pond

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00251</u>	<u>7/31/97 1100</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00252</u>	<u>7/31/97 1100</u>	<u>---</u>	<u>TDS, TSS, Sulfate</u>

Site Sketch:





ESA CONSULTANTS INC.
2637 Midpoint Drive, Suite F
Fort Collins, Colorado 80525
(970) 484-3611 (970) 484-4118 FAX

SURFACE WATER SAMPLING FORM

Station ID: DR-16-SW1

Project Name: RICO POST VCUP

Location: Rico Bay Adit

Date: 7-30-97

Time: 0820

Weather Conditions: light rain, ~60°F, raining past 12 hours

Sampling Personnel (Signature): Todd Sullivan

FIELD MEASUREMENTS

pH/Temp: 6.29 12.9°C Dissolved Oxygen/Temp (mg/L): 6.0
Elevation correction factor 0.72

Specific Conductance/Temp ($\mu\text{S}/\text{cm}$): 819 @ 12.6°C

Fe (II) (mg/L): 0.21

Fe (total)(mg/L): 0.80

Alkalinity (mg/L as CaCO_3): 695

Calculated Streamflow (cfs): 0.01

COMMENTS: algae in channel, low flow, sampled 10' down from main adit

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00233</u>	<u>7/30/97 0920</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00234</u>	<u>" "</u>	<u>---</u>	<u>TDS, TSS, Sulfate</u>

Site Sketch:



ESA CONSULTANTS INC.
2637 Midpoint Drive, Suite F
Fort Collins, Colorado 80525
(970) 484-3611 (970) 484-4118 FAX

SURFACE WATER SAMPLING FORM

Station ID: DR-18-SW1 Project Name: RICO POST VCUP

Location: DOLORES RIVER @ old bridge abutment

Date: 7-30-97 Time: 1415

Weather Conditions: Overcast - raining past 20 hours

Sampling Personnel (Signature): Todd Sullivan

FIELD MEASUREMENTS

pH/Temp: 7.31 @ 10.3°C Dissolved Oxygen/Temp (mg/L): 8.1
Elevation correction factor 0.72

Specific Conductance/Temp ($\mu\text{S}/\text{cm}$): 103.3 @ 10.6°C

Fe (II) (mg/L): 0.01 Fe (total)(mg/L): 1.30

Alkalinity (mg/L as CaCO_3): 46 Calculated Streamflow (cfs): 262 ESTIMATED @
Gaging Station

COMMENTS: Muddy water, very high flow, several normally dry side channels are now flowing

WATER QUALITY SAMPLES

Tag No.	Date/Time	Preserved	Analysis
<u>00239</u>	<u>7/30/97 1430</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness</u>
<u>00240</u>	<u>" "</u>	<u>---</u>	<u>TDS, TSS, Sulfate</u>
<u>00241</u>	<u>" "</u>	<u>HNO3</u>	<u>Dissolved Metals, Hardness (Blank)</u>
<u>00242</u>	<u>" "</u>	<u>---</u>	<u>TDS, TSS, Sulfate (Blank)</u>

Site Sketch:

**C3 Discharge Measurement
Procedures and Calculation
Sheets**

STANDARD OPERATING PROCEDURE STREAM FLOW MEASUREMENT

FIELD PROCEDURES—WADING TECHNIQUE WITH FLOW METER

Streamflow measurements of shallow and relatively slow-moving streams can be accomplished by wading. This method is preferred because of the greater freedom in selecting optimum cross-sections. A rule of thumb for calculating the maximum amount of water that can be safely waded is 12–13 ft³/second per foot of width (USGS 1977) in the channel thalweg (deepest and swiftest portion of the flow).

Two persons are required for the streamflow measurement. A sampler works in the water, setting up the transect tape and taking flow measurements. The second person, the data recorder, remains on shore to record the data called out by the sampler onto the field data sheet. Flow meters shall always be calibrated prior to going into the field.

Field procedures for the 'Wading Technique' are itemized as follows:

1. At the stream survey site, a location is selected for the stream transect. This location should have a uniform depth, preferably at least 0.5-ft deep, and uniform velocity. Areas with still or reverse currents, such as eddies behind boulders or areas with fast chutes, should be avoided. In locations of very low flow, it may be necessary to physically construct a uniform channel by moving cobbles and small boulders.
2. Next, using survey stakes, the sampler sets up headpins perpendicular to flow. The origin of the survey tape is anchored to the left headpin (looking downstream), and is stretched tautly one to two ft above the water and anchored to the right headpin.
3. The data recorder notes the left and right bank tape readings and divides the stream transect into 20–30 even increments (no more than 10 percent of the discharge should occur in an individual increment). Longer increments are appropriate for very uniform flows, shorter increments for abruptly changing flows. Locally shorter increments may be required if a small number of cells contain a majority of the flow.
4. Beginning at the first station beyond the left bank. The sampler calls out the depth above streambed. The sampler stands downstream of the tape and to the side of the measuring point, facing upstream, holding the wading rod vertically. Depths are recorded to the nearest 0.05 ft. The velocity is then called out after the meter has stabilized (approximately 10–15 seconds).
5. If the water is less than 2.5-ft deep, a single velocity reading at 40 percent of the depth above the streambed is made. The standard USGS top-set wading rod is set up to measure velocities at the 40 percent depth by adjusting a vernier scale on the rod.

6. For depths greater than 2.5 ft, readings at 20 percent and 80 percent must be recorded. These calculations may be made either mentally, and agreed upon by both persons, by using a top-setting rod set at twice and one-half the actual depth, or by using a calculator prior to taking the velocity measurements. Both velocity readings are then recorded, with a slashmark (/) separating the two.
7. The procedure is repeated at each vertical.

FIELD PROCEDURES—OTHER TECHNIQUES

Alternative techniques may be necessary when logistical constraints preclude the use of standard discharge measurements. These will be described in brief only.

1. **Surface Velocity Technique (Dunne and Leopold 1978)**—This technique estimates mean velocity from the travel time of floats between a measured distance and can give a discharge estimate in all wadable rivers. Travel time is multiplied by 0.8 to give mean velocity of a position in the cross section. These travel time determinations of velocity should be made at three or more positions across the stream and averaged to get mean channel velocity. Velocity is then multiplied by cross sectional area to give discharge.
2. **Artificial Control Sections (Church and Kellerhals 1970)**—Artificial control sections may use weirs or Parshall flumes and are particularly useful in small, steep channels. Discharge is determined by measuring the distance between the flume/weir invert and the water surface; this relationship must be calibrated in advance, but may be done prior to installation.

CALCULATIONS

The following calculations can be made either in the field office at the end of the sampling day or in the office after all fieldwork is complete.

Mean Velocity Calculation

The methods used for calculating the mean velocity at each vertical are 1) six-tenths depth method, 2) two-point method, and 3) surface method (USGS 1977).

1. **Six-tenths depth method**—A single measurement at 0.6 depth below the water surface (equal to 40 percent depth above streambed) provides the mean water column velocity. This method gives reliable results at depths between 0.3 and 2.5 ft.

2. **Two-point method**—Two measurements, at 0.2 and 0.8 depth above streambed, are averaged to provide the mean water column velocity. This method gives accurate results at depths above 2.5 ft.
3. **Surface method**—A single surface measurement is multiplied by a coefficient, usually 0.85, to calculate mean water column velocity. This method is used when velocities and depths are too low for current meter measurement.

Discharge Calculation

The velocity-area method is used to calculate total stream discharge. This method consists of summing the products of partial cross-section areas and average velocities for each of those sections. The mid-section method for calculating partial cross-section areas assumes that the velocity measurement taken at each depth sampling point represents the mean velocity in the partial rectangular cross-sectional area. This partial cross-sectional area extends laterally from half the distance from the preceding vertical to half the distance to the next vertical, and vertically from the water surface to the measured depth. This method is recommended over the mean-section method, which averages both the depth and velocity from adjacent verticals to derive the discharge between the verticals (USGS 1977).

Computations for calculating the discharge on the field data sheet are as follows:

1. The distance, depth, and velocity columns are recorded in the field.
2. Average velocities are calculated for those sections measured by the two-point and surface methods and recorded in red ink on the data sheet.
3. The segment partial areas are calculated for each vertical by adding half the distance from the previous vertical to half the distance to the next vertical, and multiplying this sum by the recorded depth. If the depth at the left or right bank (first and last vertical) is zero, the discharge for half of the first section is calculated as zero because the velocity is zero.
4. The segment flow for each vertical is calculated by multiplying segment partial area by the velocity.
5. All segment flows are totaled to arrive at total flow.

**Discharge Measurement Calculation Sheet - Rico, Colorado
Fall 1996**

Location: Argentine Seep Flow (SVS-12)
Method: Parshall Flume - Reference Table D-1
Date: October 22, 1996
water level in flume = 0.22 ft flow rate = .10 cfs

Location: Silver Swan Adit (DR-7-SW)
Method: Volumetric
Date: October 23, 1996

<u>volume (gal)</u>	<u>time (sec)</u>	<u>flow rate (gpm)</u>	<u>flow rate (cfs)</u>
1.1	5.0	13.2	.029
1.1	7.0	9.43	.021
1.1	7.0	9.43	.021
		average	.024

Location: Santa Cruz Adit Discharge (DR-8-SW)
Method: Volumetric
Date: October 23, 1996

<u>volume (gal)</u>	<u>time (sec)</u>	<u>flow rate (gpm)</u>	<u>flow rate (cfs)</u>
0.9	7.2	7.50	.017
0.9	6.6	8.16	.018
0.9	6.3	8.58	.019
0.9	6.5	8.28	.018
		average	.018

Location: Rico Boy Adit Discharge (DR-16-SW)
Method: Volumetric
Date: October 23, 1996

<u>volume (gal)</u>	<u>time (sec)</u>	<u>flow rate (gpm)</u>	<u>flow rate (cfs)</u>
1.0	15.0	4.0	.009
1.0	15.0	4.0	.009
1.0	15.0	4.0	.009
		average	.009

DISCHARGE MEASUREMENT NOTES

Location: SVS-5 Project: RICO Start Time(hrs) 11:40 AM Page 1 Of 1 Page
 Meter: Marsh McBirney Date: 10/22/96 Weather: Very Cold; 10 Deg F, Calm
 Model No. RMB 2000 Party: Todd Sullivan, Steve Story Stop Time(hrs): 1:25 PM Cross Section: 20' UPSTRM FROM CULVERT
 Computed By: BMQ Date: 16-Dec-96 Checked By: [Signature] Date: 12-16-96

Horiz Station (ft)	Width (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect. Depth (ft)	Point Prop. Velocity Depth	Mean And/Ov Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
1.00	0.00	LEW							
1.50	0.50	0.00		0.00	0.00	0.00	0.00	0.000	
2.00	0.50	0.30		0.30	-0.12	-0.12	0.15	-0.018	
2.50	0.50	0.40		0.40	-0.10	-0.10	0.20	-0.020	
3.00	0.50	0.60		0.60	0.10	0.10	0.30	0.030	
3.50	0.50	0.60		0.60	0.45	0.45	0.30	0.135	
4.00	0.50	0.60		0.60	0.62	0.62	0.30	0.186	
4.50	0.50	0.60		0.60	0.30	0.30	0.30	0.090	
5.00	0.50	0.55		0.55	0.08	0.08	0.28	0.022	
5.50	0.50	0.80		0.80	1.17	1.17	0.40	0.468	
6.00	0.50	0.80		0.80	0.42	0.42	0.40	0.168	
6.50	0.50	0.70		0.70	0.16	0.16	0.35	0.056	
7.00	0.50	0.60		0.60	0.52	0.52	0.30	0.156	
7.50	0.50	0.50		0.50	0.65	0.65	0.25	0.163	
8.00	0.50	0.60		0.60	0.29	0.29	0.30	0.087	
8.50	0.50	0.50		0.50	0.11	0.11	0.25	0.028	
9.00	0.50	0.50		0.50	0.15	0.15	0.25	0.038	
9.50	0.50	0.20		0.20	0.13	0.13	0.10	0.013	
10.00	0.50	0.30		0.30	0.16	0.16	0.15	0.024	
10.50	0.50	0.20		0.20	0.14	0.14	0.10	0.014	
11.00	0.50	REW		0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
TOTALS	10.00						4.68	1.640	

REMARKS:

DISCHARGE MEASUREMENT NOTES

Location: SVS-8 Project: RICO Start Time(hrs): 2:30 PM Page 1 Of 1 Page
 Meter: Marsh McBirney Date: 10/22/96 Weather: 25 Deg F; Calm
 Model No. RMB 2000 Party: Todd Sullivan, Steve Story Stop Time(hrs): 2:55 PM Cross Section: 30' DSTRM FROM CULVERT
 Computed By: BMG Date: 16-Dec-96 Checked By: [Signature] Date: 12-16-96

Horiz. Station (ft)	Width (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect. Depth (ft)	Prop. Depth	Point Velocity (ft/sec)	Mean And/Or Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
1.00	0.00	LEW								
1.50	0.50	0.00		0.00		0.00	0.00	0.00	0.000	
2.00	0.50	0.40		0.40		-0.02	-0.02	0.20	-0.004	
2.50	0.50	0.50		0.50		-0.05	-0.05	0.25	-0.013	
3.00	0.50	0.60		0.60		0.05	0.05	0.30	0.015	
3.50	0.50	0.75		0.75		0.10	0.10	0.38	0.038	
4.00	0.50	0.80		0.80		0.16	0.16	0.40	0.064	
4.50	0.50	0.95		0.95		0.11	0.11	0.48	0.053	
5.00	0.50	0.95		0.95		0.36	0.36	0.48	0.173	
5.50	0.50	0.90		0.90		0.50	0.50	0.45	0.225	
6.00	0.50	0.95		0.95		0.50	0.50	0.48	0.240	
6.50	0.50	1.05		1.05		0.38	0.38	0.53	0.201	
7.00	0.50	0.85		0.85		0.64	0.64	0.43	0.275	
7.50	0.50	0.90		0.90		0.81	0.81	0.45	0.365	
8.00	0.50	0.60		0.60		0.62	0.62	0.30	0.186	
8.50	0.50	0.55		0.55		0.80	0.80	0.28	0.224	
9.00	0.50	0.70		0.70		0.76	0.76	0.35	0.266	
9.50	0.50	0.40		0.40		0.08	0.08	0.20	0.016	
10.00	0.50	REW		0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
TOTALS	9.00							5.96	2.324	

REMARKS:

DISCHARGE MEASUREMENT NOTES

Location: DR-1-SW Project: RICO Start Time(hrs): 4:00 PM Page 1 Of 1 Page

Method: Float Method Date: 10/23/96 Weather: Cloudy, Windy, 45 Deg F

Model No. N/A Party: Todd Sullivan, Steve Story Stop Time(hrs): 4:25 PM Cross Section: East Channel of Dolores River

Computed By: BMG Date: 16-Dec-96 Checked By: AS Date: 12-15-96

Horiz. Station (ft)	Width (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect. Depth (ft)	Prop Depth	Point Velocity (ft/sec)	Mean And/OR Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
0.00	0.00	LEW								
0.20	0.20	0.00		0.00		0.00	0.00	0.00	0.000	
0.40	0.20	0.26		0.26		0.56	0.56	0.05	0.028	
0.60	0.20	0.28		0.28		0.66	0.66	0.06	0.040	
0.80	0.20	0.34		0.34		0.71	0.71	0.07	0.050	
1.00	0.20	0.35		0.35		0.71	0.71	0.07	0.050	
1.20	0.20	0.18		0.18		0.59	0.59	0.04	0.024	
1.40	0.20	0.32		0.32		0.71	0.71	0.06	0.043	
1.60	0.20	0.23		0.23		0.59	0.59	0.05	0.030	
1.80	0.20	0.25		0.25		0.45	0.45	0.05	0.023	
2.00	0.20	0.23		0.23		0.56	0.56	0.05	0.028	
2.20	0.20	0.04		0.04		0.48	0.48	0.01	0.005	
2.40	0.20	0.17		0.17		0.48	0.48	0.03	0.014	
2.60	0.20	0.21		0.21		0.40	0.40	0.04	0.016	
2.80	0.20	0.15		0.15		0.24	0.24	0.03	0.007	
3.00	0.20	0.05		0.05		0.23	0.23	0.01	0.002	
3.20	0.20	0.00		0.00		0.00	0.00	0.00	0.000	
3.40	0.20	0.15		0.15		0.22	0.22	0.03	0.007	
3.60	0.20	0.13		0.13		0.21	0.21	0.03	0.006	
3.80	0.20	0.10		0.10		0.19	0.19	0.02	0.004	
4.00	0.20	REW		0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
TOTALS	4.00							0.70	0.377	

REMARKS:

DISCHARGE MEASUREMENT NOTES

Location: DR-2-SW Project: RICO Start Time(hrs): 11:23 AM Page 1 Of 1 Page
 Meter: Marsh McBimney Date: 10/24/96 Weather: Slightly Windy, 45 Deg F
 Model No. RMB 2000 Party: Todd Sullivan, Steve Story Stop Time(hrs): 11:45 AM Cross Section: Near the West RICO Bridge
 Computed By: BMG Date: 16-Dec-96 Checked By: [Signature] Date: 12-16-96

Horiz. Station (ft)	Width (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect. Depth (ft)	Point Velocity (ft/sec)	Mean And/Or Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
4.00	0.00	LEW							
5.00	1.00	0.90		0.90	0.14	0.14	0.90	0.126	
6.00	1.00	1.50		1.50	1.03	1.03	1.50	1.545	
7.00	1.00	1.90		1.90	2.39	2.39	1.90	4.541	
8.00	1.00	1.80		1.80	2.34	2.34	1.80	4.212	
9.00	1.00	1.90		1.90	2.17	2.17	1.90	4.123	
10.00	1.00	1.70		1.70	2.14	2.14	1.70	3.638	
11.00	1.00	1.60		1.60	2.17	2.17	1.60	3.472	
12.00	1.00	1.40		1.40	1.72	1.72	1.40	2.408	
13.00	1.00	1.20		1.20	1.61	1.61	1.20	1.932	
14.00	1.00	1.40		1.40	1.79	1.79	1.40	2.506	
15.00	1.00	1.30		1.30	1.35	1.35	1.30	1.755	
16.00	1.00	1.10		1.10	1.80	1.80	1.10	1.980	
17.00	1.00	1.30		1.30	1.30	1.30	1.63	2.119	
18.50	1.50	1.10		1.10	1.14	1.14	1.65	1.881	
20.00	1.50	1.00		1.00	1.21	1.21	1.50	1.815	
21.50	1.50	0.80		0.80	0.78	0.78	1.20	0.936	
23.00	1.50	0.60		0.60	0.82	0.82	0.90	0.738	
24.50	1.50	0.60		0.60	0.75	0.75	0.90	0.675	
26.00	1.50	0.50		0.50	0.43	0.43	0.75	0.323	
27.50	1.50	0.30		0.30	-0.04	-0.04	0.53	-0.021	
29.50	2.00	REW		0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
TOTALS	25.50						26.76	40.704	

REMARKS:

DISCHARGE MEASUREMENT NOTES

Location: DR-4-SW Project: RICO Start Time(hrs): 8:50 AM Page 1 Of 1 Page
 Meter: Marsh McBirney Date: 10/24/96 Weather: Calm, 0 Deg F
 Model No. RMB 2000 Party: Todd Sullivan, Steve Story Stop Time(hrs): 9:30 AM Cross Section: Downstream from RICO
 Computed By: BMG Date: 16-Dec-96 Checked By: [Signature] Date: 12-16-96

Horiz. Station (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect. Depth (ft)	Prop. Depth	Point Velocity (ft/sec)	Mean And/Or Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
4.00	0.00	LEW							
5.00	1.00	0.20	0.20		0.00	0.00	0.25	0.000	
6.50	1.50	0.30	0.30		0.00	0.00	0.45	0.000	
8.00	1.50	0.30	0.30		0.09	0.09	0.45	0.041	
9.50	1.50	0.60	0.60		0.38	0.38	0.90	0.342	
11.00	1.50	0.80	0.80		0.53	0.53	1.20	0.636	
12.50	1.50	0.90	0.90		0.85	0.85	1.35	1.148	
14.00	1.50	1.10	1.10		0.55	0.55	1.65	0.908	
15.50	1.50	1.50	1.50		1.06	1.06	2.25	2.385	
17.00	1.50	1.60	1.60		1.87	1.87	2.40	4.488	
18.50	1.50	1.90	1.90		1.87	1.87	2.85	5.330	
20.00	1.50	1.80	1.80		2.51	2.51	2.70	6.777	
21.50	1.50	1.70	1.70		2.25	2.25	2.55	5.738	
23.00	1.50	1.90	1.90		1.57	1.57	2.85	4.475	
24.50	1.50	1.80	1.80		1.61	1.61	2.70	4.347	
26.00	1.50	1.30	1.30		0.88	0.88	1.95	1.716	
27.50	1.50	0.70	0.70		0.19	0.19	1.05	0.200	
29.00	1.50	0.70	0.70		0.21	0.21	1.05	0.221	
30.50	1.50	0.20	0.20		0.00	0.00	0.30	0.000	
32.00	1.50	REW	0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
TOTALS	28.00						28.90	38.752	

REMARKS:

DISCHARGE MEASUREMENT NOTES

Location:	<u>DR-6-SW</u>	Project:	<u>RICO</u>	Start Time(hrs):	<u>10:45 AM</u>	Page 1 Of 1 Page	
Method:	<u>Float Method</u>	Date:	<u>10/23/96</u>		Weather: <u>Clear, Calm, 40 Deg F</u>		
Model No.	<u>N/A</u>	Party:	<u>Todd Sullivan, Steve Story</u>	Stop Time(hrs):	<u>11:20 AM</u>	Cross Section: <u>Silver Swan Wetlands Discharge</u>	
Computed By:	<u>BMG</u>	Date:	<u>16-Dec-96</u>	Checked By:	<u>[Signature]</u>	Date:	<u>12-16-96</u>

Horiz. Station (ft)	Width (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect. Depth (ft)	Prop. Depth	Point Velocity (ft/sec)	Mean And/Or Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
0.00	0.00	LEW								
0.10	0.10	0.17		0.17		0.00	0.00	0.02	0.000	
0.20	0.10	0.17		0.17		0.09	0.09	0.02	0.002	
0.30	0.10	0.14		0.14		0.00	0.00	0.01	0.000	
0.40	0.10	0.14		0.14		0.22	0.22	0.01	0.002	
0.50	0.10	0.20		0.20		0.34	0.34	0.02	0.007	
0.60	0.10	0.20		0.20		0.33	0.33	0.02	0.007	
0.70	0.10	0.20		0.20		0.42	0.42	0.02	0.008	
0.80	0.10	0.20		0.20		0.40	0.40	0.02	0.008	
0.90	0.10	0.20		0.20		0.53	0.53	0.02	0.011	
1.00	0.10	0.19		0.19		0.43	0.43	0.03	0.013	
1.20	0.20	0.16		0.16		0.38	0.38	0.02	0.008	
1.30	0.10	0.17		0.17		0.20	0.20	0.02	0.004	
1.40	0.10	0.15		0.15		0.00	0.00	0.02	0.000	
1.50	0.10	0.08		0.08		0.00	0.00	0.01	0.000	
1.60	0.10	0.03		0.03		0.00	0.00	0.00	0.000	
1.70	0.10	REW		0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
TOTALS	1.70							0.26	0.070	

REMARKS:

DISCHARGE MEASUREMENT NOTES

Location.	<u>DR-9-SW</u>	Project.	<u>RICO</u>	Start Time(hrs):	<u>12:00 PM</u>	Page 1 of 1 Page	
Method.	<u>Float Method</u>	Date.	<u>10/23/96</u>	Weather: <u>Slightly Windy, 55 Deg C</u>			
Model No.	<u>N/A</u>	Party:	<u>Todd Sullivan, Steve Story</u>	Stop Time(hrs):	<u>12:30 PM</u>	Cross Section: <u>Santa Cruz Wetlands Discharge</u>	
Computed By:	<u>BMG</u>	Date:	<u>16-Dec-96</u>	Checked By:	<u>[Signature]</u>	Date:	<u>12-16-96</u>

Horiz Station (ft)	Width (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect. Depth (ft)	Prop. Depth	Point Velocity (ft/sec)	Mean And/Or Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
0.00	0.00	LEW								
0.20	0.20	0.04		0.04		0.27	0.27	0.01	0.003	
0.40	0.20	0.10		0.10		0.31	0.31	0.02	0.006	
0.60	0.20	0.17		0.17		0.33	0.33	0.03	0.010	
0.80	0.20	0.22		0.22		0.37	0.37	0.04	0.015	
1.00	0.20	0.31		0.31		0.32	0.32	0.06	0.019	
1.20	0.20	0.34		0.34		0.37	0.37	0.07	0.026	
1.40	0.20	0.35		0.35		0.36	0.36	0.07	0.025	
1.60	0.20	0.30		0.30		0.32	0.32	0.06	0.019	
1.80	0.20	0.22		0.22		0.37	0.37	0.04	0.015	
2.00	0.20	0.11		0.11		0.40	0.40	0.02	0.008	
2.20	0.20	0.05		0.05		0.42	0.42	0.01	0.004	
2.40	0.20	0.02		0.02		0.33	0.33	0.00	0.000	
2.60	0.20	REW		0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
TOTALS	2.60							0.43	0.150	

REMARKS:

DISCHARGE MEASUREMENT NOTES

Location: DR-18-SW Project: RICO Start Time(hrs): 10:23 AM Page 1 Of 1 Page
 Meter: Marsh McBirney Date: 10/24/96 Weather: Clear, Calm, 20 Deg C
 Model No. RMB 2000 Party: Todd Sullivan, Steve Story Stop Time(hrs): 10:50 AM Cross Section: At Abandon Bridge Abutment
 Computed By: BMG Date: 16-Dec-96 Checked By: [Signature] Date: 12-16-96

Horiz. Station (ft)	Width (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect. Depth (ft)	Prop. Depth	Point Velocity (ft/sec)	Mean And/Or Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
4.00	0.00	LEW								
6.00	2.00	0.35		0.35		-0.02	-0.02	0.70	-0.014	
8.00	2.00	0.50		0.50		0.11	0.11	1.00	0.110	
10.00	2.00	1.10		1.10		0.12	0.12	2.20	0.264	
12.00	2.00	1.50		1.50		0.22	0.22	3.00	0.660	
14.00	2.00	2.00		2.00		0.37	0.37	4.00	1.480	
16.00	2.00	2.35		2.35		0.52	0.52	4.70	2.444	
18.00	2.00	2.60		2.60		0.57	0.57	5.20	2.964	
20.00	2.00	2.30		2.30		0.65	0.65	4.60	2.990	
22.00	2.00	2.40		2.40		0.46	0.46	4.80	2.208	
24.00	2.00	2.20		2.20		0.93	0.93	4.40	4.092	
26.00	2.00	1.90		1.90		0.90	0.90	3.80	3.420	
28.00	2.00	1.90		1.90		1.12	1.12	3.80	4.256	
30.00	2.00	1.70		1.70		1.05	1.05	3.40	3.570	
32.00	2.00	1.50		1.50		0.89	0.89	3.00	2.670	
34.00	2.00	1.50		1.50		0.84	0.84	3.00	2.520	
36.00	2.00	1.00		1.00		0.72	0.72	2.00	1.440	
38.00	2.00	0.55		0.55		0.07	0.07	1.10	0.077	
40.00	2.00	REW		0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
TOTALS	36.00							54.70	35.151	

REMARKS:

**Discharge Measurement Calculation Sheet - Rico, Colorado
Winter 1997**

Location: Argentine Seep Flow (SVS-12)
 Method: Parshall Flume - Reference Table D-1
 Date: January 21, 1997
 water level in flume = 0.25 ft flow rate = .12 cfs = 53.9 gpm

Location: Santa Cruz Adit Discharge (DR-8-SW)
 Method: Volumetric
 Date: January 22, 1997

<u>volume (gal)</u>	<u>time (sec)</u>	<u>flow rate (gpm)</u>	<u>flow rate (cfs)</u>
0.96	4.0	14.4	.032
0.96	4.0	14.4	.032
0.90	3.5	15.4	.034
		average 14.7	average .033

Location: Rico Boy Adit Discharge (DR-16-SW)
 Method: Volumetric
 Date: January 22, 1997

<u>volume (gal)</u>	<u>time (sec)</u>	<u>flow rate (gpm)</u>	<u>flow rate (cfs)</u>
1.9	33.0	3.45	.008
2.0	34.0	3.53	.008
2.0	34.0	3.53	.008
		average 3.50	average .008

DISCHARGE MEASUREMENT NOTES

Location: DR-1-SW Project: RICO Start Time(hrs): 2:40 Page 1 Of 1 Page

Method: Floating Velocity Date: Jan. 22, 1997 Weather: 30 degrees F, calm, 2 ft of snow

Model No. NA Party: Todd Sullivan/Steve Story Stop Time(hrs): 3:10 Cross Section: East channel of Dolores River

Computed By: TAS Date: 19-Mar-97 Checked By: BMG/JS Date: 20-Mar-97

Horiz. Station (ft)	Width (ft)	Total Depth Of Water (ft)	Point Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
-0.25	0.00	LEW				
0.00	0.00	0.40	0.00	0.10	0.000	
0.25	0.25	0.52	0.56	0.13	0.073	
0.50	0.25	0.62	0.66	0.16	0.106	
0.75	0.25	0.44	0.71	0.11	0.078	
1.00	0.25	0.48	0.71	0.12	0.085	
1.25	0.25	0.31	0.59	0.08	0.047	
1.50	0.25	0.22	0.71	0.06	0.043	
1.75	0.25	0.30	0.59	0.08	0.047	
2.00	0.25	0.15	0.45	0.04	0.018	
2.25	0.25	0.05	0.56	0.01	0.006	
2.50	0.25	0.10	0.48	0.03	0.014	
2.75	0.25	0.06	0.48	0.02	0.010	
3.00	0.25	0.05	0.40	0.01	0.004	
3.25	0.25	0.05	0.24	0.01	0.002	
3.50	0.25	0.00	0.23	0.00	0.000	
3.75	0.25	REW				
TOTALS	3.75			0.96	0.533	

REMARKS:

**Discharge Measurement Calculation Sheet - Rico, Colorado
Spring 1997**

Location: Argentine Seep Flow (SVS-12)
Method: Parshall Flume - Reference Table D-1
Date: April 16, 1997
water level in flume = 0.24 ft flow rate = .11 cfs = 49 gpm

Location: Santa Cruz Adit Discharge (DR-8-SW)
Method: Volumetric
Date: April 16, 1997

<u>volume (gal)</u>	<u>time (sec)</u>	<u>flow rate (gpm)</u>	<u>flow rate (cfs)</u>
1.0	2.0	30	0.067
1.0	2.5	24	0.054
1.0	1.9	32	<u>0.070</u>
average			0.064 less 20% = 0.051 cfs

Location: Rico Boy Adit Discharge (DR-16-SW)
Method: Volumetric
Date: April 16, 1997

<u>volume (gal)</u>	<u>time (sec)</u>	<u>flow rate (gpm)</u>	<u>flow rate (cfs)</u>
1.8	17.2	6.28	0.014
1.9	17.4	6.55	0.015
1.7	15.6	6.54	<u>0.015</u>
average			0.015 cfs

DISCHARGE MEASUREMENT NOTES

Location:	<u>SVS-5</u>	Project:	<u>RJCO</u>	Start Time(hrs):	<u>11:20 AM</u>	Page 1 Of 1 Page	
Meter:	<u>Marsh McBirney</u>	Date:	<u>04/16/97</u>	Description: <u>Moderate Flow - 2' of Snow on Banks</u>			
Model No.	<u>RMB 2000</u>	Party:	<u>Todd Sullivan, Bill Schenderlein</u>	Stop Time(hrs):	<u> </u>		
Computed By:	<u>BMG</u>	Date:	<u>15-May-97</u>	Checked By:	<u> </u>	Date:	<u> </u>

Horiz Station (ft)	Width (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect. Depth (ft)	Prop. Depth	Point Velocity (ft/sec)	Mean And/Or Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
1.00	0.00	0.00								
1.25	0.25	0.15		0.15		0.62	0.62	0.04	0.025	
1.50	0.25	0.25		0.25		0.03	0.03	0.06	0.002	
1.75	0.25	0.30		0.30		0.10	0.10	0.08	0.008	
2.00	0.25	0.30		0.30		0.01	0.01	0.08	0.001	
2.25	0.25	0.30		0.30		0.53	0.53	0.08	0.042	
2.50	0.25	0.30		0.30		0.95	0.95	0.08	0.076	
2.75	0.25	0.30		0.30		1.72	1.72	0.08	0.138	
3.00	0.25	0.35		0.35		2.05	2.05	0.09	0.185	
3.25	0.25	0.35		0.35		2.09	2.09	0.09	0.188	
3.50	0.25	0.45		0.45		2.14	2.14	0.11	0.235	
3.75	0.25	0.60		0.60		2.38	2.38	0.15	0.357	
4.00	0.25	0.60		0.60		1.72	1.72	0.15	0.258	
4.25	0.25	0.60		0.60		2.17	2.17	0.15	0.326	
4.50	0.25	0.55		0.55		1.40	1.40	0.14	0.196	
4.75	0.25	0.55		0.55		0.91	0.91	0.19	0.173	
5.20	0.45	0.50		0.50		1.07	1.07	0.11	0.118	
5.20	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
TOTALS	4.20							1.68	2.328	

REMARKS:

DISCHARGE MEASUREMENT NOTES

Location: SVS-8		Project: RICO		Start Time(hrs): 3:10 PM		Page 1 Of 1 Page	
Meter: Marsh McBinney		Date: 04/16/97		Stop		Description: Silver Creek Below Argentine Tailings	
Model No. RMB 2000		Party: Todd Sullivan, Bill Schenderlein		Time(hrs):		25 feet below culvert	
Computed By: BMG		Checked By:		Date: 02-Jun-97		Date:	

Horiz. Station (ft)	Width (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect. Depth (ft)	Prop. Depth	Point Velocity (ft/sec)	Mean And/Or Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
1.00	0.00	L&W								
1.50	0.50	0.20		0.20		0.00	0.00	0.10	0.000	
2.00	0.50	0.30		0.30		-0.08	-0.08	0.15	-0.012	
2.50	0.50	0.45		0.45		0.00	0.00	0.23	0.000	
3.00	0.90	0.55		0.55		0.03	0.03	0.28	0.008	
3.50	0.50	0.65		0.65		0.05	0.05	0.33	0.017	
4.00	0.50	0.70		0.70		0.12	0.12	0.35	0.042	
4.50	0.50	0.90		0.90		0.14	0.14	0.45	0.063	
5.00	0.50	0.95		0.95		0.40	0.40	0.48	0.192	
5.50	0.50	0.85		0.85		0.53	0.53	0.43	0.228	
6.00	0.50	1.00		1.00		0.39	0.39	0.50	0.195	
6.50	0.50	0.60		0.60		0.49	0.49	0.30	0.147	
7.00	0.50	0.90		0.90		0.69	0.69	0.45	0.311	
7.50	0.50	0.80		0.80		0.87	0.87	0.40	0.348	
8.00	0.50	0.50		0.50		0.86	0.86	0.25	0.215	
8.50	0.50	0.50		0.50		0.58	0.58	0.25	0.145	
9.00	0.50	0.65		0.65		0.75	0.75	0.33	0.248	
9.50	0.50	0.65		0.65		0.75	0.75	0.16	0.120	
9.50	0.00	R&W		0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
TOTALS	8.50							5.44	2.267	

REMARKS:



REMARKS:

DISCHARGE MEASUREMENT NOTES

Location:	<u>DR-2-SW</u>	Project:	<u>RICO</u>	Start Time(hrs):	<u>12:00 PM</u>	Page 1 Of 1 Page
Meter:	<u>Marsh McBiney</u>	Date:	<u>04/18/97</u>	Description: <u>Dolores River at West Rico Bridge</u>		
Model No.	<u>RMB 2000</u>	Party:	<u>Todd Sullivan, Bill Schenderlein</u>	Stop Time(hrs):	<u></u>	
Computed By:	<u>BMG</u>	Date:	<u>02-Jun-97</u>	Checked By:	<u></u>	Date:

Horiz. Station (ft)	Width (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect. Depth (ft)	Prop. Depth	Point Velocity (ft/sec)	Mean And/Or Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
7.50	0.00	REW								
8.00	0.50	0.30		0.30		0.14	0.14	0.38	0.053	
10.00	2.00	0.45		0.45		0.52	0.52	0.90	0.468	
12.00	2.00	0.50		0.50		0.03	0.03	1.00	0.030	
14.00	2.00	0.65		0.65		1.26	1.26	1.30	1.638	
16.00	2.00	0.90		0.90		1.90	1.90	1.80	3.420	
18.00	2.00	1.10		1.10		1.95	1.95	2.20	4.290	
20.00	2.00	0.50		0.50		2.30	2.30	1.00	2.300	
22.00	2.00	1.00		1.00		1.81	1.81	2.00	3.620	
24.00	2.00	1.40		1.40		2.34	2.34	2.80	6.552	
26.00	2.00	1.50		1.50		3.12	3.12	3.00	9.360	
28.00	2.00	1.60		1.60		2.53	2.53	3.20	8.096	
30.00	2.00	1.60		1.60		2.50	2.50	3.20	8.000	
32.00	2.00	2.40		2.40		2.02	2.02	4.80	9.696	
34.00	2.00	2.30		2.30		2.66	2.66	4.60	12.236	
36.00	2.00	1.40		1.40		1.44	1.44	2.45	3.528	
37.50	1.50	0.80		0.80		0.66	0.66	0.60	0.396	
37.50	0.00	LEW		0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
TOTALS	30.00							35.23	73.683	

REMARKS:

DISCHARGE MEASUREMENT NOTES

Location:	<u>DR-4-SW</u>	Project:	<u>RICO</u>	Start Time(hrs):	<u>8:00 AM</u>	Page 1 Of 1 Page
Meter:	<u>Marsh McBiney</u>	Date:	<u>04/18/97</u>	Description: <u>Dolores River at Rico Cemetery</u>		
Model No.	<u>RMB 2000</u>	Party:	<u>Todd Sullivan, Bill Schenderlein</u>	Stop Time(hrs):	<u></u>	
Computed By:	<u>BMG</u>	Date:	<u>03-Jun-97</u>	Checked By:	<u></u>	Date:

Horiz. Station (ft)	Width (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect. Depth (ft)	Prop. Depth	Point Velocity (ft/sec)	Mean And/Or Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
4.50	0.00	REW								
4.50	1.50	0.35		0.35		0.00	0.00	0.53	0.000	
6.00	1.50	0.60		0.60		0.91	0.91	0.90	0.819	
7.50	1.50	1.00		1.00		0.31	0.31	1.50	0.465	
9.00	1.50	1.90		1.90		1.49	1.49	2.85	4.247	
10.50	1.50	2.10		2.10		1.46	1.46	3.15	4.599	
12.00	1.50	2.10		2.10		2.66	2.66	3.15	8.379	
13.50	1.50	2.20		2.20		2.71	2.71	3.30	8.943	
15.00	1.50	2.00		2.00		2.99	2.99	3.00	8.970	
16.50	1.50	2.30		2.30		2.94	2.94	3.45	10.143	
18.00	1.50	2.00		2.00		2.25	2.25	3.00	6.750	
19.50	1.50	1.50		1.50		1.93	1.93	2.25	4.343	
21.00	1.50	1.40		1.40		1.38	1.38	2.10	2.898	
22.50	1.50	1.10		1.10		1.23	1.23	1.65	2.030	
24.00	1.50	0.90		0.90		1.08	1.08	1.35	1.458	
25.50	1.50	0.80		0.80		0.87	0.87	1.20	1.044	
27.00	1.50	0.60		0.60		0.94	0.94	0.90	0.846	
28.50	1.50	0.60		0.60		1.54	1.54	0.90	1.386	
30.00	1.50	0.40		0.40		1.00	1.00	0.60	0.600	
31.50	1.50	0.30		0.30		0.45	0.45	0.45	0.203	
33.00	1.50	0.30		0.30		0.44	0.44	4.95	2.178	
34.50	0.00	LEW		0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
TOTALS	30.00							41.18	70.301	

REMARKS:

DISCHARGE MEASUREMENT NOTES

Location:	<u>DR-6-SW</u>	Project:	<u>RICO</u>	Start Time(hrs):	<u>3:30 PM</u>	Page 1 Of 1 Page
Method:	<u>Float Method</u>	Date:	<u>04/17/97</u>	Description: <u>Moderate Flow, Clear</u>		
Model No.	<u>N/A</u>	Party:	<u>Todd Sullivan, Bill Schenderlein</u>	Stop Time(hrs):	<u></u>	
Computed By:	<u>BMG</u>	Date:	<u>15-May-97</u>	Checked By:	<u></u>	Date:

Horiz. Station (ft)	Width (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect Depth (ft)	Prop. Depth	Point Velocity (ft/sec)	Mean And/Or Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
0.00	0.00	0.00								
0.25	0.25	0.10		0.10		0.58	0.58	0.03	0.017	
0.50	0.25	0.13		0.13		0.93	0.93	0.03	0.028	
0.75	0.25	0.24		0.24		1.32	1.32	0.06	0.079	
1.00	0.25	0.28		0.28		1.20	1.20	0.07	0.084	
1.25	0.25	0.31		0.31		1.36	1.36	0.08	0.109	
1.50	0.25	0.33		0.33		1.08	1.08	0.08	0.086	
1.75	0.25	0.31		0.31		0.97	0.97	0.08	0.078	
2.00	0.25	0.29		0.29		0.75	0.75	0.07	0.053	
2.25	0.25	0.17		0.17		0.63	0.63	0.04	0.025	
2.50	0.25	0.11		0.11		0.41	0.41	0.03	0.012	
2.75	0.25	0.08		0.08		0.00	0.00	0.01	0.000	
2.75	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
TOTALS	2.75							0.58	0.571	

REMARKS:

DISCHARGE MEASUREMENT NOTES

Location:	<u>DR-9-SW</u>	Project:	<u>RICO</u>	Start Time(hrs):	<u>11:25 PM</u>	Page 1 Of 1 Page	
Method:	<u>Float Method</u>	Date:	<u>04/17/97</u>				
Model No.	<u>N/A</u>	Party:	<u>Todd Sullivan, Bill Schenderlein</u>	Stop Time(hrs):	<u></u>	Description: <u>Low Flow, Clear</u>	
Computed By:	<u>BMG</u>	Date:	<u>02-Jun-97</u>	Checked By:	<u></u>	Date:	<u></u>

Horiz Station	Width (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect. Depth (ft)	Prop. Depth	Point Velocity (ft/sec)	Mean And/Or Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
0.00	0.00	REW								
0.25	0.25	0.80		0.80		0.21	0.21	0.20	0.042	
0.50	0.25	0.12		0.12		0.40	0.40	0.03	0.012	
0.75	0.25	0.22		0.22		0.48	0.48	0.06	0.029	
1.00	0.25	0.29		0.29		0.55	0.55	0.07	0.039	
1.25	0.25	0.39		0.39		0.60	0.60	0.10	0.060	
1.50	0.25	0.43		0.43		0.67	0.67	0.11	0.074	
1.75	0.25	0.49		0.49		0.52	0.52	0.12	0.062	
2.00	0.25	0.51		0.51		0.48	0.48	0.13	0.062	
2.25	0.25	0.45		0.45		0.61	0.61	0.11	0.067	
2.50	0.25	0.37		0.37		0.67	0.67	0.09	0.060	
2.75	0.25	0.24		0.24		0.62	0.62	0.06	0.037	
3.00	0.25	0.10		0.10		0.56	0.56	0.03	0.017	
3.25	0.25	0.05		0.05		0.49	0.49	0.01	0.005	
3.50	0.25	0.05		0.05		0.43	0.43	0.01	0.004	
3.50	0.00	LEW		0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
TOTALS	3.50							1.13	0.570	

REMARKS:

DISCHARGE MEASUREMENT NOTES

Location:	DR-18-SW	Project:	RICO	Start Time(hrs):	10:50 AM	Page 1 of 1 Page
Meter:	Marsh McBirney	Date:	04/18/97	Description: Dolores River at Old Bridge Abutment		
Model No.	RMB 2000	Party:	Todd Sullivan, Bill Schenderlein	Stop Time(hrs):		
Computed By:	BMO	Date:	27-May-97	Checked By:		Date:

Horiz. Station (ft)	Width (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect. Depth (ft)	Point Prop. Velocity Depth	Mean And/Or Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
9.00	0.00	REW							
11.00	2.00	0.65		0.65	0.52	0.52	1.30	0.676	
13.00	2.00	1.20		1.20	1.00	1.00	2.40	2.400	
15.00	2.00	1.50		1.50	1.37	1.37	3.00	4.110	
17.00	2.00	1.30		1.30	1.78	1.78	2.60	4.628	
19.00	2.00	1.70		1.70	1.80	1.80	3.40	6.120	
21.00	2.00	2.00		2.00	1.64	1.64	4.00	6.560	
23.00	2.00	2.20		2.20	1.47	1.47	4.40	6.468	
25.00	2.00	2.40		2.40	1.31	1.31	4.80	6.288	
27.00	2.00	2.30		2.30	1.14	1.14	4.60	5.244	
29.00	2.00	2.30		2.30	1.19	1.19	4.60	5.474	
31.00	2.00	2.50		2.50	1.18	1.18	5.00	5.900	
33.00	2.00	2.30		2.30	1.01	1.01	4.60	4.646	
35.00	2.00	1.80		1.80	0.84	0.84	3.60	3.024	
37.00	2.00	1.40		1.40	0.80	0.80	2.80	2.240	
39.00	2.00	1.30		1.30	0.68	0.68	2.60	1.768	
41.00	2.00	0.85		0.85	0.55	0.55	1.70	0.935	
43.00	2.00	0.65		0.65	0.26	0.26	1.30	0.338	
45.00	2.00	LEW		0.00	0.00	0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.000	
TOTALS	36.00						56.70	66.819	

REMARKS:

**Discharge Measurement Calculation Sheet - Rico, Colorado
Summer 1997**

Location: Argentine Seep Flow (SVS-12)
Method: Parshall Flume - Reference Table D-1
Date: July 29, 1997
water level in flume = 0.27 ft flow rate = 0.13 cfs

Location: Rico Boy Adit (DR-16-SW)
Method: Volumetric
Date: July 30, 1997


<u>volume (gal)</u>	<u>time (sec)</u>	<u>flow rate (gpm)</u>	<u>flow rate (cfs)</u>
1.5	14.6	6.2	0.01
1.6	15.3	6.3	0.01
1.8	15.1	7.2	<u>0.02</u>
		Average	0.01

DISCHARGE MEASUREMENT NOTES

Location: SVS-5 Project: RICO Start Time(hrs): 11:15AM Page 1 Of 1 Page

Meter: Marsh McBirney Date: 7/29/97 Weather: Overcast, 70 degrees, Rain past 72 hours

Model No. RMB 2000 Party: Todd Sullivan, Bill Schenderlein Stop Time(hrs): 11:25AM Cross Section: 20' UPSTRM FROM CULVERT

Computed By: TAS Date: Aug. 4, 97 Checked By:  Date: 8-5-97

Horiz. Station (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect. Depth (ft)	Prop. Depth	Point elocity (ft/sec)	Mean And/Or Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
2.58	0.00	LEW							
2.83	0.25	0.20	0.20		-0.04	-0.04	0.05	-0.002	
3.08	0.25	0.20	0.20		0.08	0.08	0.05	0.004	
3.33	0.25	0.40	0.40		0.82	0.82	0.10	0.082	
3.58	0.25	0.35	0.35		1.00	1.00	0.09	0.090	
3.83	0.25	0.25	0.25		0.26	0.26	0.06	0.016	
4.08	0.25	0.40	0.40		0.15	0.15	0.10	0.015	
4.33	0.25	0.45	0.45		1.27	1.27	0.11	0.140	
4.58	0.25	0.45	0.45		1.26	1.26	0.11	0.139	
4.83	0.25	0.40	0.40		1.07	1.07	0.10	0.107	
5.08	0.25	0.35	0.35		1.13	1.13	0.12	0.136	
5.50	0.42	0.45	0.45		1.42	1.42	0.21	0.298	
6.00	0.50	0.65	0.65		0.72	0.72	0.33	0.238	
6.50	0.50	0.80	0.80		2.56	2.56	0.40	1.024	
7.00	0.50	0.90	0.90		2.63	2.63	0.45	1.184	
7.50	0.50	0.90	0.90		1.92	1.92	0.45	0.864	
8.00	0.50	0.90	0.90		1.08	1.08	0.45	0.486	
8.50	0.50	0.60	0.60		1.02	1.02	0.30	0.306	
9.00	0.50	0.55	0.55		0.74	0.74	0.28	0.207	
9.50	0.50	0.55	0.55		0.27	0.27	0.28	0.076	
10.00	0.50	0.45	0.45		0.55	0.55	0.23	0.127	
10.50	0.50	0.50	0.50		0.57	0.57	0.25	0.143	
11.00	0.50	0.00	0.00			0.00	0.00	0.000	
	0.00	REW	0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
	0.00		0.00			0.00	0.00	0.000	
TOTALS	8.42						4.52	5.680	

REMARKS:

DISCHARGE MEASUREMENT NOTES

Location: SVS-8 Project: RICO Start Time(hrs): 2:50P Page 1 of 1 Page
 Meter: Marsh McBirney Date: 7/29/97 Weather: Overcast, 70 Deg F; Rain past 72 hours
 Model No. RMB 2000 Party: Todd Sullivan, Bill Schenderlein Stop Time(hrs): 1:15PM Cross Section: 30' DSTRM FROM CULVERT
 Computed By: TAS Date: Aug. 4, 97 Checked By: [Signature] Date: 8-5-97

Horiz. Station	Width (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect. Depth (ft)	Prop. Depth	Point elocity (ft/sec)	Mean And/OR Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
1.00	0.00	LEW								
1.50	0.50	0.20		0.20		0.00	0.00	0.10	0.000	
2.00	0.50	0.40		0.40		0.20	0.20	0.20	0.040	
2.50	0.50	0.50		0.50		0.21	0.21	0.25	0.053	
3.00	0.50	0.40		0.40		0.42	0.42	0.20	0.084	
3.50	0.50	0.50		0.50		0.59	0.59	0.25	0.148	
4.00	0.50	0.50		0.50		0.79	0.79	0.25	0.198	
4.50	0.50	0.60		0.60		1.08	1.08	0.30	0.324	
5.00	0.50	0.65		0.65		1.25	1.25	0.33	0.413	
5.50	0.50	0.95		0.95		1.53	1.53	0.48	0.734	
6.00	0.50	1.10		1.10		1.48	1.48	0.55	0.814	
6.50	0.50	1.00		1.00		1.31	1.31	0.50	0.655	
7.00	0.50	0.90		0.90		1.26	1.26	0.45	0.567	
7.50	0.50	0.80		0.80		1.57	1.57	0.40	0.628	
8.00	0.50	0.75		0.75		1.33	1.33	0.38	0.505	
8.50	0.50	0.50		0.50		0.96	0.96	0.25	0.240	
9.00	0.50	0.85		0.85		0.77	0.77	0.43	0.331	
9.50	0.50	0.60		0.60		0.58	0.58	0.30	0.174	
10.00	0.50	0.50		0.50		0.30	0.30	0.25	0.075	
10.50	0.50	0.50		0.50		0.26	0.26	0.25	0.065	
11.00	0.50	0.02		0.02		0.00	0.00	0.02	0.000	
12.00	1.00	REW		0.00		0.00	0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.00	0.000	
	0.00			0.00		0.00	0.00	0.00	0.000	
TOTALS	11.00							6.14	6.048	

REMARKS:

DISCHARGE MEASUREMENT NOTES

Location: DR-1-SW Project: RICO Start Time(hrs): 4:15PM Page 1 Of 1 Page
 Meter: Marsh McBirney Date: 7/29/97 Weather: Overcast, 60 Deg F; Light Rain
 Model No. RMB 2000 Party: Todd Sullivan, Bill Schenderlein Stop Time(hrs): 4:50 PM Cross Section: 20' up from confluence
 Computed By: TAS Date: Aug. 4, 97 Checked By: JS Date: 8-5-97

Horiz. Station (ft)	Width (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect Depth (ft)	Prop. Depth	Point elocity (ft/sec)	Mean And/OR Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
4.00	0.00	LEW								
5.00	1.00	0.60		0.60		0.00	0.00	0.60	0.000	
6.00	1.00	0.90		0.90		1.68	1.68	0.90	1.512	
7.00	1.00	1.50		1.50		2.60	2.60	1.50	3.900	
8.00	1.00	1.80		1.80		3.39	3.39	1.80	6.102	
9.00	1.00	1.80		1.80		1.93	1.93	1.80	3.474	
10.00	1.00	1.50		1.80		3.40	3.40	1.50	5.100	
11.00	1.00	1.50		1.50		4.34	4.34	1.50	6.510	
12.00	1.00	1.60		1.50		4.58	4.58	1.60	7.328	
13.00	1.00	1.60		1.60		4.09	4.09	1.60	6.544	
14.00	1.00	1.60		1.60		3.53	3.53	1.60	5.648	
15.00	1.00	1.50		1.60		2.56	2.56	1.50	3.840	
16.00	1.00	1.50		1.50		2.93	2.93	1.50	4.395	
17.00	1.00	1.30		1.50		2.65	2.65	1.30	3.445	
18.00	1.00	1.10		1.30		2.68	2.68	1.10	2.948	
19.00	1.00	1.10		1.10		3.00	3.00	1.10	3.300	
20.00	1.00	1.10		1.10		3.55	3.55	1.10	3.905	
21.00	1.00	1.00		1.10		2.74	2.74	1.00	2.740	
22.00	1.00	0.90		1.00		2.38	2.38	0.90	2.142	
23.00	1.00	0.90		0.90		1.95	1.95	0.90	1.755	
24.00	1.00	0.90		0.90		2.22	2.22	0.90	1.998	
25.00	1.00	0.70		0.90		1.50	1.50	0.70	1.050	
26.00	1.00	0.30		0.70		0.04	0.04	0.30	0.012	
27.00	1.00			0.30		-0.16	-0.16	0.00	0.000	
28.00	1.00	REW		0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
	0.00			0.00			0.00	0.00	0.000	
TOTALS	24.00							26.70	77.648	

REMARKS:

DISCHARGE MEASUREMENT NOTES

Location: DR-6-SW Project: RICO Start Time(hrs): 10:50PM Page 1 Of 1 Page
 Meter: Marsh McBirney Date: 7/29/97 Weather: Overcast, 60 Deg F
 Model No. RMB 2000 Party: Todd Sullivan, Bill Schenderlein Stop Time(hrs): 11:00 AM Cross Section: 20' up from confluence
 Computed By: TAS Date: Aug. 4, 97 Checked By: _____ Date: _____

Horiz. Station (ft)	Width (ft)	Total Depth Of Water (ft)	Water Surface To Bot. Of Ice (ft)	Effect. Depth (ft)	Prop. Depth	Point elocity (ft/sec)	Mean And/Or Ice Cor. Vertical Velocity (ft/sec)	Cell Area (sq ft)	Cell Disch. (cfs)	Other/Comments
0.00	0.00	LEW								
0.25	0.25	0.55		0.55		2.54	2.54	0.14	0.356	
0.50	0.25	0.55		0.55		2.16	2.16	0.14	0.302	
0.75	0.25	0.30		0.30		1.76	1.76	0.06	0.106	
0.92	0.17	0.25		0.25		1.06	1.06	0.06	0.064	
1.25	0.33	0.15		0.15		0.00	0.00	0.03	0.000	
1.38	0.13	REW					0.00	0.00	0.000	
								0.83		channel # 1 draining upper pond
0.00	0.00	LEW								
0.25	0.25	0.13		0.13		0.58	0.58	0.03	0.017	
0.50	0.25	0.15		0.15		0.67	0.67	0.04	0.027	
0.75	0.25	0.18		0.18		0.64	0.64	0.05	0.032	
1.00	0.25	0.20		0.20		0.58	0.58	0.05	0.029	
1.25	0.25	0.20		0.20		0.51	0.51	0.05	0.026	
1.50	0.25	0.20		0.20		0.90	0.90	0.05	0.045	
1.75	0.25	0.18		0.18		0.71	0.71	0.05	0.036	
2.00	0.25	0.18		0.18		0.46	0.46	0.05	0.023	
2.25	0.25	REW					0.00	0.00	0.000	
								0.37	0.24	channel #2 draining lower pond
							Total Flow	1.07		

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Station DR-15a-SW

Comment:

Solve For Actual Discharge

Given Input Data:

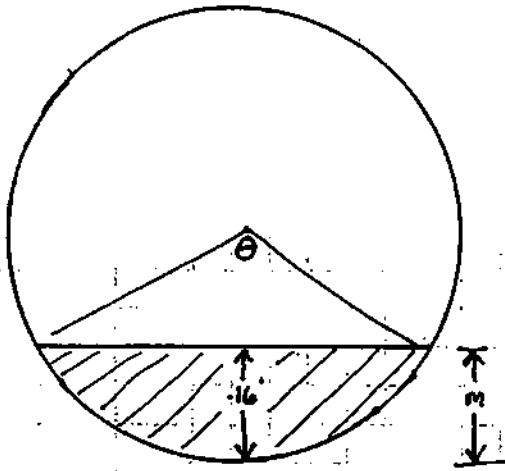
Diameter.....	1.25 ft
Slope.....	0.1000 ft/ft
Manning's n.....	0.014
Depth.....	0.16 ft

Computed Results:

Discharge.....	0.66 cfs
Velocity.....	7.24 fps
Flow Area.....	0.09 sf
Critical Depth....	0.32 ft
Critical Slope....	0.0061 ft/ft
Percent Full.....	12.80 %
Full Capacity.....	18.97 cfs
QMAX @.94D.....	20.40 cfs
Froude Number.....	3.85 (flow is Supercritical)

ESA Consultants

JOB NO. _____ SUBJECT DR-15a-SW SHEET NO. _____ OF _____
 PROJECT _____ Flow Calculations through Culvert BY _____ DATE _____



1.25 ft dia. culvert, 24.4 ft length

$$\text{Avg. Velocity (floatation method)} = \frac{24.4'}{3.35 \text{ sec}} = 7.2 \text{ ft/s}$$

Area: $A = \frac{r^2}{2} \left(\frac{\pi \theta}{180} - \sin \theta \right) = \frac{(.625)^2}{2} (1.46 - .994) = .09 \text{ ft}^2$

$$r = \frac{m^2 + \frac{1}{4} c^2}{2m} = \frac{\frac{1}{2} c}{\sin \frac{1}{2} \theta}$$

$$c = .835 \rightarrow \theta = 83.8^\circ$$

$$Q = A \times \text{Velocity} = \boxed{0.66 \text{ cfs}}$$

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Station DR-7-SW

Comment:

Solve For Actual Discharge

Given Input Data:

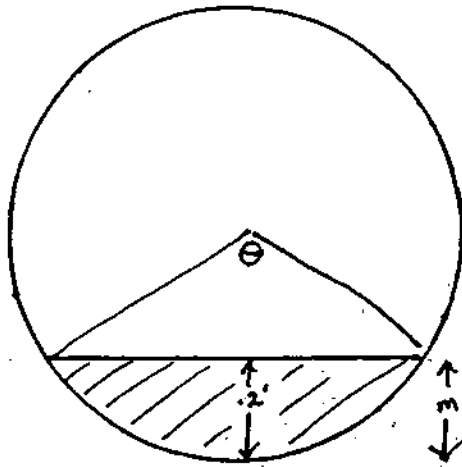
Diameter.....	1.25 ft
Slope.....	0.0400 ft/ft
Manning's n.....	0.030
Depth.....	0.20 ft

Computed Results:

Discharge.....	0.31 cfs
Velocity.....	2.45 fps
Flow Area.....	0.13 sf
Critical Depth....	0.22 ft
Critical Slope....	0.0292 ft/ft
Percent Full.....	16.00 %
Full Capacity.....	5.60 cfs
QMAX @.94D.....	6.02 cfs
Froude Number.....	1.16 (flow is Supercritical)

ESA Consultants

JOB NO. _____ SUBJECT DR-7-SW SHEET NO. _____ OF _____
 PROJECT Flow Calculations BY _____ DATE _____



1.25 ft. Dia. Culvert, 55 ft length

$$\text{Avg. Velocity (floatation method)} = \frac{55'}{23s} = 2.39 \text{ ft/s}$$

$$\text{Area: } A = \frac{r^2}{2} \left(\frac{\pi \theta}{180} - \sin \theta \right) = \frac{(.625)^2}{2} \left(\frac{\pi (94.3)}{180} - \sin 94.3 \right) = .126 \text{ ft}^2$$

$$r = \frac{m^2 + \frac{1}{4} c^2}{2m} = \frac{\frac{1}{2} c}{\sin \frac{1}{2} \theta}$$

$$c = 0.92 \rightarrow \theta = 94.3^\circ$$

$$Q = \text{Area} \times \text{Velocity} = \boxed{0.30 \text{ cfs}}$$

TABLE D-1 ARGENTINE TAILINGS SEEP FLOW CALCULATION
(SVS-12)

DISCHARGE OF 3" PARSHALL FLUME

FORMULAS: $CFS = .992H^{1.547}$ $GS = CFS \times 7.481$ $MGD = CFS \times 0.6463$

HEAD FT.	CFS	GS	MGD	HEAD FT.	CFS	GS	MGD	HEAD FT.	CFS	GS	MGD	HEAD FT.	CFS	GS	MGD	HEAD FT.	CFS	GS	MGD
0.01	.0008	.0060	.0005	0.26	.1234	.9235	.0798	0.51	.3500	2.619	.2262	0.76	.6428	4.854	.4193	1.01	1.007	7.536	.6511
0.02	.0023	.0175	.0015	0.27	.1309	.9790	.0848	0.52	.3607	2.699	.2331	0.77	.6621	4.953	.4279	1.02	1.023	7.652	.6611
0.03	.0044	.0327	.0028	0.28	.1384	1.036	.0895	0.53	.3715	2.779	.2401	0.78	.6754	5.053	.4365	1.03	1.038	7.768	.6711
0.04	.0068	.0510	.0044	0.29	.1462	1.093	.0945	0.54	.3824	2.861	.2471	0.79	.6889	5.153	.4452	1.04	1.054	7.885	.6812
0.05	.0096	.0721	.0062	0.30	.1540	1.152	.0996	0.55	.3934	2.943	.2543	0.80	.7024	5.255	.4540	1.05	1.070	8.003	.6914
0.06	.0128	.0956	.0083	0.31	.1620	1.212	.1047	0.56	.4045	3.026	.2615	0.81	.7160	5.357	.4628	1.06	1.086	8.121	.7016
0.07	.0162	.1213	.0105	0.32	.1702	1.273	.1100	0.57	.4158	3.110	.2687	0.82	.7298	5.459	.4716	1.07	1.101	8.240	.7119
0.08	.0199	.1491	.0129	0.33	.1785	1.335	.1154	0.58	.4271	3.195	.2760	0.83	.7436	5.563	.4806	1.08	1.117	8.359	.7222
0.09	.0239	.1789	.0155	0.34	.1869	1.399	.1208	0.59	.4386	3.281	.2834	0.84	.7575	5.667	.4896	1.09	1.133	8.479	.7326
0.10	.0282	.2106	.0182	0.35	.1955	1.463	.1264	0.60	.4501	3.367	.2909	0.85	.7715	5.771	.4986	1.10	1.150	8.600	.7430
0.11	.0326	.2441	.0211	0.36	.2042	1.528	.1320	0.61	.4618	3.454	.2984	0.86	.7856	5.877	.5077	1.11	1.166	8.721	.7535
0.12	.0373	.2792	.0241	0.37	.2131	1.594	.1377	0.62	.4735	3.542	.3060	0.87	.7997	5.983	.5169	1.12	1.182	8.843	.7640
0.13	.0422	.3160	.0273	0.38	.2220	1.661	.1435	0.63	.4854	3.631	.3137	0.88	.8140	6.090	.5261	1.13	1.198	8.966	.7746
0.14	.0474	.3544	.0306	0.39	.2311	1.729	.1494	0.64	.4974	3.721	.3214	0.89	.8284	6.197	.5354	1.14	1.215	9.089	.7852
0.15	.0527	.3944	.0341	0.40	.2404	1.798	.1554	0.65	.5094	3.811	.3292	0.90	.8428	6.305	.5447	1.15	1.231	9.212	.7959
0.16	.0582	.4358	.0376	0.41	.2497	1.868	.1614	0.66	.5216	3.902	.3371	0.91	.8573	6.414	.5541	1.16	1.248	9.337	.8066
0.17	.0640	.4786	.0413	0.42	.2592	1.939	.1675	0.67	.5339	3.994	.3451	0.92	.8719	6.523	.5635	1.17	1.265	9.461	.8174
0.18	.0699	.5229	.0452	0.43	.2688	2.011	.1737	0.68	.5463	4.087	.3531	0.93	.8867	6.633	.5730	1.18	1.281	9.587	.8282
0.19	.0760	.5685	.0491	0.44	.2786	2.084	.1800	0.69	.5587	4.180	.3611	0.94	.9014	6.744	.5826	1.19	1.298	9.713	.8391
0.20	.0823	.6154	.0532	0.45	.2884	2.158	.1864	0.70	.5713	4.274	.3692	0.95	.9163	6.855	.5922	1.20	1.315	9.839	.8500
0.21	.0887	.6637	.0573	0.46	.2984	2.232	.1929	0.71	.5840	4.369	.3774	0.96	.9313	6.967	.6019	1.21	1.332	9.966	.8610
0.22	.0953	.7132	.0616	0.47	.3085	2.308	.1994	0.72	.5968	4.464	.3857	0.97	.9463	7.080	.6116	1.22	1.349	10.09	.8721
0.23	.1021	.7639	.0660	0.48	.3187	2.384	.2060	0.73	.6096	4.561	.3940	0.98	.9615	7.193	.6214	1.23	1.366	10.22	.8831
0.24	.1091	.8159	.0705	0.49	.3290	2.462	.2127	0.74	.6226	4.658	.4024	0.99	.9767	7.307	.6312	1.24	1.384	10.35	.8943
0.25	.1162	.8691	.0751	0.50	.3395	2.540	.2194	0.75	.6357	4.755	.4108	1.00	.9920	7.421	.6411	1.25	1.401	10.48	.9055

From: Grant. D.M. 1979. Open channel flow measurement handbook. Instrumentation specialties Company, Lincoln, NE.

APPENDIX D

LABORATORY ANALYTICAL REPORTS

- D1 Fall Quarter 1996**
- D2 Winter Quarter 1997**
- D3 Spring Quarter 1997**
- D4 Summer Quarter 1997**

D1 Fall Quarter 1996



November 22, 1996

Service Request No: K9606826

Laura Jones
PTI Environmental Services
4000 Kruse Way Place, Building Two, Suite 285
Lake Oswego, OR 97035

Re: RICO/CA47-0601

Dear Laura:

Enclosed are the results of the sample(s) submitted to our laboratory on October 25, 1996. Preliminary results were transmitted via facsimile on November 21, 1996. For your reference, these analyses have been assigned our service request number K9606826.

All analyses were performed consistent with our laboratory's quality assurance program. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed.

Please call if you have any questions. My extension is 246.

Respectfully submitted,

Columbia Analytical Services, Inc.

A handwritten signature in cursive script, appearing to read "Abbie Spielman".

Abbie Spielman
Client Services Manager

AS/td

Page 1 of 347

cc: Todd Sullivan (ESA/Fort Collins)

COLUMBIA ANALYTICAL SERVICES, Inc.

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
J	Estimated concentration. The value is less than the method reporting limit, but greater than the method detection limit.
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NAN	Not Analyzed
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected at or above the MRL
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

00002

RICO POST VCUP SURFACE WATER SAMPLING - FALL QUARTER 1996

<u>TAG NUMBER</u>	<u>SAMPLING LOCATION</u>	<u>DATE/TIME</u>	<u>ANALYSIS</u>
00123	SVS-5	10-22-96/1201	DISSOLVED METALS, HARDNESS
00124	SVS-5	10-22-96/1201	TDS, TSS, SULFATE
00125	SVS-8	10-22-96/1415	DISSOLVED METALS, HARDNESS
00126	SVS-8	10-22-96/1415	TDS, TSS, SULFATE
00127	SVS-11	10-22-96/1505	DISSOLVED METALS, HARDNESS
00128	SVS-11	10-22-96/1505	TDS, TSS, SULFATE
00129	SVS-12	10-22-96/1625	DISSOLVED METALS, HARDNESS
00130	SVS-12	10-22-96/1625	TDS, TSS, SULFATE
00131	SVS-12	10-22-96/1625	CYANIDE
00132	SVS-12	10-22-96/1625	PCE
00133	SVS-12	10-22-96/1625	PCE
00134	SVS-12	10-22-96/1625	PCE
00135	SVS-12	10-22-96/1625	DISSOLVED METALS, HARDNESS (DUPE)
00136	SVS-12	10-22-96/1625	TDS, TSS, SULFATE (DUPE)
00137	SVS-12	10-22-96/1625	CYANIDE (DUPE)
00138	SVS-12	10-22-96/1625	PCE (DUPE)
00139	SVS-12	10-22-96/1625	PCE (DUPE)
00140	SVS-12	10-22-96/1625	PCE (DUPE) — not analyzed
00141	DR-7-SW	10-23-96/0915	DISSOLVED METALS, HARDNESS
00142	DR-7-SW	10-23-96/0915	TDS, TSS, SULFATE
00143	DR-6-SW	10-23-96/1040	DISSOLVED METALS, HARDNESS
00144	DR-6-SW	10-23-96/1040	TDS, TSS, SULFATE
00145	DR-9-SW	10-23-96/1150	DISSOLVED METALS, HARDNESS
00146	DR-9-SW	10-23-96/1150	TDS, TSS, SULFATE
00147	DR-16-SW	10-23-96/1400	DISSOLVED METALS, HARDNESS (BLANK)
00148	DR-16-SW	10-23-96/1400	TDS, TSS, SULFATE (BLANK)
00149	DR-16-SW	10-23-96/1400	DISSOLVED METALS, HARDNESS
00150	DR-16-SW	10-23-96/1400	TDS, TSS, SULFATE
00151	DR-8-SW	10-23-96/1445	DISSOLVED METALS (incl. Hg), HARDNESS
00152	DR-8-SW	10-23-96/1445	TDS, TSS, SULFATE
00153	DR-1-SW	10-23-96/1550	DISSOLVED METALS, HARDNESS
00154	DR-1-SW	10-23-96/1550	TDS, TSS, SULFATE
00155	DR-1-SW	10-23-96/1550	CYANIDE
00156	DR-4-SW	10-24-96/0900	DISSOLVED METALS, HARDNESS
00157	DR-4-SW	10-24-96/0900	TDS, TSS, SULFATE
00158	DR-18-SW	10-24-96/1015	DISSOLVED METALS, HARDNESS
00159	DR-18-SW	10-24-96/1015	TDS, TSS, SULFATE
00160	DR-2-SW	10-24-96/1115	DISSOLVED METALS, HARDNESS
00161	DR-2-SW	10-24-96/1115	TDS, TSS, SULFATE

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
 Project: RICO/CA47-0601
 Sample Matrix: Water

Service Request: K9606826
 Date Collected: 10/22-24/96
 Date Received: 10/25/96
 Date Extracted: NA

Inorganic Parameters
 Units: mg/L (ppm)

Analyte:	Solids, Total Dissolved (TDS)	Solids, Total Suspended (TSS)	Sulfate
EPA Method:	160.1	160.2	300.0
Method Reporting Limit:	5	5	0.2
Date Analyzed:	10/28-30/96	10/28-30/96	11/2,9,10/96

Sample Name	Lab Code			
00157	K9606826-002	233	5	78
00159	K9606826-004	234	ND	90
00161	K9606826-006	228	ND	80
00142	K9606826-008	910	ND	200
00144	K9606826-010	233	ND	55
00146	K9606826-012	576	ND	200
00148	K9606826-014	ND	ND	ND
00150	K9606826-016	1350	ND	390
00152	K9606826-018	1210	ND	280
00154	K9606826-020	296	15	130
00124	K9606826-023	159	ND	24
00126	K9606826-025	190	6	64
00128	K9606826-027	832	26	510
00130	K9606826-029	760	ND	390
00136	K9606826-035	751	6	410
Method Blank	K9606826-MB	ND	ND	ND

Approved By: 

Date: 11/12/96 00003

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO/CA47-0601
Sample Matrix: Water

Service Request: K9606826
Date Collected: 10/22,23/96
Date Received: 10/25/96
Date Extracted: NA
Date Analyzed: 10/28/96

Cyanide, Total
EPA Method 335.2
Units: mg/L (ppm)

Sample Name	Lab Code	MRL	Result
00155	K9606826-021	0.01	ND
00131	K9606826-030	0.01	ND
00137	K9606826-036	0.01	ND
Method Blank	K9606826-MB	0.01	ND

Approved By: _____

Date: _____

11/12/96

00004

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: Rico SW Monitoring/CA47-0601
Sample Matrix: Water

Service Request: K9606826
Date Collected: 10/22-24/96
Date Received: 10/25/96
Date Extracted: 11/4,6/96
Date Analyzed: 11/6/96

Hardness, as CaCO₃
EPA Method 6010A/ SM Method 2340B
Units: mg/L (ppm)

Sample Name	Lab Code	MRL	Result
00156	K9606826-001	0.2	171
00158	K9606826-003	0.2	172
00160	K9606826-005	0.2	169
00141	K9606826-007	0.2	738
00143	K9606826-009	0.2	189
00145	K9606826-011	0.2	433
00147	K9606826-013	0.2	ND
00149	K9606826-015	0.2	1020
00151	K9606826-017	0.2	1020
00153	K9606826-019	0.2	214
00123	K9606826-022	0.2	114
00125	K9606826-024	0.2	151
00127	K9606826-026	0.2	618
00129	K9606826-028	0.2	533
00135	K9606826-034	0.2	545
Method Blank	K9606826-MB	0.2	ND

SM *Standard Method for the Examination of Water and Wastewater*, 18th Ed.,

Approved By: _____

Date: _____

11/11/96

00005

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: Rico SW Monitoring/CA47-0601
Sample Matrix: Water

Service Request: K9606826
Date Collected: 10/22-24/96
Date Received: 10/25/96
Date Extracted: 11/4,6/96

Dissolved Metals
Units: µg/L (ppb)

Sample Name:	00156	00158	00160
Lab Code:	K9606826-001	K9606826-003	K9606826-005
Date Analyzed:	11/6/96	11/6/96	11/6/96

Analyte	EPA Method	MRL			
Cadmium	200.8	0.02	0.53	0.52	0.59
Copper	6010A	10	ND	ND	ND
Iron	6010A	20	112	107	57
Lead	200.8	0.02	0.12	0.12	0.12
Manganese	6010A	5	175	180	172
Silver	200.8	0.02	ND	ND	ND
Zinc	6010A	10	124	123	123

Approved By: _____

Date: _____

11/11/96

00006

Analytical Report

Service Request: K9606826
Date Collected: 10/22-24/96
Date Received: 10/25/96
Date Extracted: 11/4.6/96

Units: $\mu\text{g/L}$ (ppb)

Sample Name:	00141	00143	00145
Lab Code:	K9606826-007	K9606826-009	K9606826-011
Date Analyzed:	11/6/96	11/6/96	11/6/96

Analyte	EPA	MRL	mg/kg		
	Method		1	2	3
Cadmium	200.8	0.02	0.72	0.87	0.61
Copper	6010A	10	ND	ND	ND
Iron	6010A	20	8370	51	247
Lead	200.8	0.02	5.60	0.35	0.11
Manganese	6010A	5	1700	183	854
Silver	200.8	0.02	ND	ND	ND
Zinc	6010A	10	883	224	168

Date:

Date: 11/11/96 00007

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: Rico SW Monitoring/CA47-0601
Sample Matrix: Water

Service Request: K9606826
Date Collected: 10/22-24/96
Date Received: 10/25/96
Date Extracted: 11/4,6/96

Dissolved Metals
Units: µg/L (ppb)

Sample Name:	00147	00149	00151
Lab Code:	K9606826-013	K9606826-015	K9606826-017
Date Analyzed:	11/6/96	11/6/96	11/6/96

Analyte	EPA Method	MRL			
Cadmium	200.8	0.02	0.03	15.0	1.96
Copper	6010A	10	ND	ND	14
Iron	6010A	20	ND	63	59
Lead	200.8	0.02	0.06	2.38	0.18
Manganese	6010A	5	ND	811	203
Mercury	7470	0.2	-	-	ND
Silver	200.8	0.02	ND	ND	ND
Zinc	6010A	10	ND	9080	1300

Approved By: _____

Date: _____

11/11/96

00008

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: Rico SW Monitoring/CA47-0601
Sample Matrix: Water

Service Request: K9606826
Date Collected: 10/22-24/96
Date Received: 10/25/96
Date Extracted: 11/4,6/96

Dissolved Metals
Units: µg/L (ppb)

Sample Name:	00153	00123	00125
Lab Code:	K9606826-019	K9606826-022	K9606826-024
Date Analyzed:	11/6/96	11/6/96	11/6/96

Analyte	EPA				
	Method	MRL			
Cadmium	200.8	0.02	5.32	3.44	2.28
Copper	6010A	10	15	14	ND
Iron	6010A	20	6090	156	141
Lead	200.8	0.02	1.09	2.65	0.88
Manganese	6010A	5	1660	138	392
Silver	200.8	0.02	ND	ND	ND
Zinc	6010A	10	1950	677	738

Approved By: _____ Date: 11/11/96

00009

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: Rico SW Monitoring/CA47-0601
Sample Matrix: Water

Service Request: K9606826
Date Collected: 10/22-24/96
Date Received: 10/25/96
Date Extracted: 11/4,6/96

Dissolved Metals
Units: µg/L (ppb)

Sample Name:	00127	00129	00135
Lab Code:	K9606826-026	K9606826-028	K9606826-034
Date Analyzed:	11/6/96	11/6/96	11/6/96

Analyte	EPA Method	MRL			
Cadmium	200.8	0.02	2.12	3.45	3.48
Copper	6010A	10	ND	ND	ND
Iron	6010A	20	5080	5880	6010
Lead	200.8	0.02	0.04	1.02	0.92
Manganese	6010A	5	6880	4990	5100
Silver	200.8	0.02	ND	ND	ND
Zinc	6010A	10	5410	5530	5640

Approved By: _____

Date: _____

11/11/96

00010

Analytical Report

Service Request: K9606826
Date Collected: NA
Date Received: NA
Date Extracted: 11/4.6/96

Dissolved Metals
Units: µg/L (ppb)

Sample Name: Method Blank
Lab Code: K9606826-MB
Date Analyzed: 11/6/96

Analyte	EPA		
	Method	MRL	
Cadmium	200.8	0.02	ND
Copper	6010A	10	ND
Iron	6010A	20	ND
Lead	200.8	0.02	ND
Manganese	6010A	5	ND
Mercury	7470	0.2	ND
Silver	200.8	0.02	ND
Zinc	6010A	10	ND

00011

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO/#CA47-0601
Sample Matrix: Water

Service Request: K9606826
Date Collected: 10/22/96
Date Received: 10/25/96
Date Extracted: NA

Halogenated Volatile Organic Compounds
EPA Methods 5030A/8010B
Units: µg/L (ppb)

Analyte	MRL	Sample Name: 00132	00133	00134
		Lab Code: K9606826-031	K9606826-032	K9606826-033
		Date Analyzed: 11/5/96	11/5/96	11/5/96
Tetrachloroethene (PCE)	0.5	ND	ND	ND

Approved By: _____

Date: _____

00012

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RJCO/#CA47-0601
Sample Matrix: Water

Service Request: K9606826
Date Collected: 10/22/96
Date Received: 10/25/96
Date Extracted: NA

Halogenated Volatile Organic Compounds
EPA Methods 5030A/8010B
Units: µg/L (ppb)

	Sample Name:	00138	00139	Method Blank
	Lab Code:	K9606826-037	K9606826-038	K961105-MB
	Date Analyzed:	11/5/96	11/5/96	11/5/96
Analyte	MRL			
Tetrachloroethene (PCE)	0.5	ND	ND	ND

Approved By: _____

[Signature]

Date: _____

11/13/96

00013



ESA CONSULTANTS INC.

C

SAMPLE ANALYSIS REQUEST/CHAIN OF CUSTODY FORM

Samples sent to:

ABBIE SPIELMAN
CAS
1317 S. 13th Ave
Kelso WA 98626

FOR LAB USE

LAB ID. _____

Send Analytical Results to:

ESA Consultants Inc.
2637 Midpoint Drive, Suite F
Fort Collins, Colorado 80525
Attn: Todd Sullivan

Project Name: Rico
Project Number: 101 9601 051
Contact Person: TODD SULLIVAN
Telephone No.: 970 484 3611

TAG NUMBER	CONTAINER/ PRESERVATIVE	ANALYSIS
00123	1L HNO ₃	Diss. Metals, Hardness
00124	1L	TDS, TSS, SO ₄
00125	1L HNO ₃	Diss. Metals, Hardness
00126	1L	TDS, TSS, SO ₄
00127	1L HNO ₃	Diss. Metals, Hardness
00128	1L	TDS, TSS, SO ₄
00129	1L HNO ₃	Diss. Metals, Hardness
00130	1L	TDS, TSS, SO ₄
00131	1L NaOH	Cyanide
00132	40ml HCl	PCE
00133	40ml HCl	PCE
00134	40ml HCl	PCE
00135	1L HNO ₃	Diss. Metals, Hardness
00136	1L	TDS, TSS, SO ₄
00137	1L NaOH	Cyanide
00138	40ml HCl	PCE
00139	40ml HCl	PCE
00140	40ml HCl	PCE

SAMPLES RELINQUISHED BY			SAMPLES RECEIVED BY			FORM NO.
Signature	Date	Time	Signature	Date	Time	
<i>T. Sullivan</i>	10/24/96	1400	<i>[Signature]</i>	10/24/96	1000	
						00035



ESA CONSULTANTS INC.

B

SAMPLE ANALYSIS REQUEST/CHAIN OF CUSTODY FORM

Samples sent to:

ABBIE SPIELMAN
CAS
1317 S. 13th Ave
KELSO WA 98626

FOR LAB USE

LAB ID _____

Send Analytical Results to:

ESA Consultants Inc.
2637 Midpoint Drive, Suite F
Fort Collins, Colorado 80525
Attn: Todd Sullivan

Project Name: Rico
Project Number: 101 9601 051
Contact Person: TODD SULLIVAN
Telephone No.: 970 493-62 484-3611

TAG NUMBER	CONTAINER/ PRESERVATIVE	ANALYSIS
00141	1L HNO ₃	Diss. Metals, Hardness
00142	1L	TDS TSS SO ₄
00143	1L HNO ₃	Diss. Metals, Hardness
00144	1L	TDS TSS SO ₄
00145	1L HNO ₃	Diss. Metals, Hardness
00146	1L	TDS TSS SO ₄
00147	1L HNO ₃	Diss. Metals, Hardness
00148	1L	TDS TSS SO ₄
00149	1L HNO ₃	Diss. Metals, Hardness
00150	1L	TDS TSS SO ₄
00151	1L HNO ₃	Diss. Metals incl. Mercury Hardness
00152	1L	TDS TSS SO ₄
00153	1L HNO ₃	Diss. Metals, Hardness
00154	1L	TDS TSS SO ₄
00155	1L	Cyanide

SAMPLES RELINQUISHED BY		SAMPLES RECEIVED BY		FORM NO. 00034
Signature: <u>T. Sullivan</u>	Date: <u>10/24/96</u> Time: <u>1400</u>	Signature: <u>[Signature]</u>	Date: <u>10/25/96</u> Time: <u>1000</u>	
Signature: _____	Date: _____ Time: _____	Signature: _____	Date: _____ Time: _____	
Signature: _____	Date: _____ Time: _____	Signature: _____	Date: _____ Time: _____	

A

SAMPLE ANALYSIS REQUEST/CHAIN OF CUSTODY FORM

Samples sent to:

ABBIE SPIELMAN
COLUMBIA ANALYTICAL SERVICES
1317 S. 13th Ave
Kelso WA 98626

FOR LAB USE

LAB ID. _____

Send Analytical Results to:

ESA Consultants Inc.
2637 Midpoint Drive, Suite F
Fort Collins, Colorado 80525
Attn: Todd Sullivan

Project Name: Rico
Project Number: 101 9601 OSI
Contact Person: TOOD SULLIVAN
Telephone No.: 770 484-3611

[illegible]

D2 Winter Quarter 1997



February 18, 1997

Service Request No: K9700452

Laura Jones
PTI Environmental Services
4000 Kruse Way Place, Building Two, Suite 285
Lake Oswego, OR 97035

Re: RICO POST-VCUP/Project #CB41-01-01

Dear Laura:

Enclosed are the results of the sample(s) submitted to our laboratory on January 24, 1997. Preliminary results were transmitted via facsimile on February 7, 1997. For your reference, these analyses have been assigned our service request number K9700452.

All analyses were performed according to our laboratory's quality assurance program. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed.

Please call if you have any questions. My extension is 246.

Respectfully submitted,

Columbia Analytical Services, Inc.


Abbie Spielman
Client Services Manager

AS/II

Page 1 of 1

cc: Todd Sullivan, ESA Consultants Inc., Fort Collins, CO

RICO SURFACE WATER SAMPLING - WINTER QUARTER 1997

<u>TAG NUMBER</u>	<u>SAMPLING LOCATION</u>	<u>DATE/TIME</u>	<u>ANALYSIS</u>
00162	SVS-12	1-21-97/1045	DISS. METALS, HARDNESS
00163	SVS-12	1-21-97/1045	TDS, TSS, SULFATE
00164	SVS-11	1-21-97/1345	DISS. METALS, HARDNESS
00165	SVS-11	1-21-97/1345	TDS, TSS, SULFATE
00166	SVS-8	1-21-97/1415	DISS. METALS, HARDNESS
00167	SVS-8	1-21-97/1415	TDS, TSS, SULFATE
00168	DR-16-SW	1-22-97/0918	DISS. METALS, HARDNESS
00169	DR-16-SW	1-22-97/0918	TDS, TSS, SULFATE
00170	DR-8-SW	1-22-97/0940	DISS. METALS, HARDNESS
00171	DR-8-SW	1-22-97/0940	TDS, TSS, SULFATE
00172	FILTER BLANK	1-22-97/0940	DISS. METALS, HARDNESS
00173	BOTTLE BLANK	1-22-97/0940	TDS, TSS, SULFATE
00174	DR-7-SW	1-22-97/1100	DISS. METALS, HARDNESS
00175	DR-7-SW	1-22-97/1100	TDS, TSS, SULFATE
00176	DR-9-SW	1-22-97/1220	DISS. METALS, HARDNESS
00177	DR-9-SW	1-22-97/1220	TDS, TSS, SULFATE
00178	DR-1-SW	1-22-97/1430	DISS. METALS, HARDNESS
00179	DR-1-SW	1-22-97/1430	TDS, TSS, SULFATE
00180	DR-4-SW	1-23-97/0900	DISS. METALS, HARDNESS
00181	DR-4-SW	1-23-97/0900	TDS, TSS, SULFATE
00182	DR-18-SW	1-23-97/0925	DISS. METALS, HARDNESS
00183	DR-18-SW	1-23-97/0925	TDS, TSS, SULFATE
00184	DR-2-SW	1-23-97/1030	DISS. METALS, HARDNESS
00185	DR-2-SW	1-23-97/1030	TDS, TSS, SULFATE
00186	DR-2-SW (DUPE)	1-23-97/1030	DISS. METALS, HARDNESS
00187	DR-2-SW (DUPE)	1-23-97/1030	TDS, TSS, SULFATE

COLUMBIA ANALYTICAL SERVICES, INC.

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-01-01
Sample Matrix: Water

Service Request No.: K9700452
Date Received: 1/24/97

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of Columbia Analytical Services, Inc. (CAS). This report contains analytical results for sample(s) designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP) and Matrix Spike (MS).

All EPA recommended holding times have been met for analyses in this sample delivery group.

The following difficulties were experienced during analysis of this batch:

The Matrix Spike (MS) recoveries of Iron, Manganese and Zinc for sample 00162 were not calculated. The analyte concentration in the sample was significantly higher than the added spike concentration, preventing accurate evaluation of the spike recovery.

Approved by

Ami Spilner

Date

2/18/97

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-01-01
Sample Matrix: Water

Service Request: K9700452
Date Collected: 1/21-23/97
Date Received: 1/24/97
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

Analyte:	Solids, Total Dissolved (TDS)	Solids, Total Suspended (TSS)	Sulfate
EPA Method:	160.1	160.2	300.0
Method Reporting Limit:	5	5	0.2
Date Analyzed:	1/27,29/97	1/27,29/97	2/6/97

Sample Name	Lab Code			
00163	K9700452-002	662	10	330
00165	K9700452-004	972	ND	560
00167	K9700452-006	237	ND	81
00169	K9700452-008	1200	ND	360
00171	K9700452-010	1110	ND	250
00173	K9700452-012	22	ND	ND
00175	K9700452-014	850	ND	170
00177	K9700452-016	100	6	160
00179	K9700452-018	353	16	150
00181	K9700452-020	299	ND	110
00183	K9700452-022	293	ND	110
00185	K9700452-024	301	ND	100
00187	K9700452-026	283	ND	100
Method Blank	K9700452-MB	ND	ND	ND

Approved By: _____ *A* Date: *2/18/97*

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-01-01
Sample Matrix: Water

Service Request: K9700452
Date Collected: 1/21-23/97
Date Received: 1/24/97
Date Extracted: 1/31-2/3/97

Dissolved Metals
Units: µg/L (ppb)

Sample Name:	00162	00164	00166
Lab Code:	K9700452-001	K9700452-003	K9700452-005
Date Analyzed:	2/3/97	2/3/97	2/3/97

Analyte	EPA Method	MRL			
Cadmium	200.8	0.02	0.58	2.12	1.78
Copper	6010A	10	ND	ND	ND
Iron	6010A	20	10200	53	148
Lead	200.8	0.5	2.0	ND	ND
Manganese	6010A	5	5250	3610	615
Silver	200.8	0.02	ND	ND	ND
Zinc	6010A	10	4710	2190	840

Approved By: _____

Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
 Project: RICO POST-VCUP/CB41-01-01
 Sample Matrix: Water

Service Request: K9700452
 Date Collected: 1/21-23/97
 Date Received: 1/24/97
 Date Extracted: 1/31-2/3/97

Dissolved Metals
 Units: µg/L (ppb)

Sample Name:	00168	00170	00172
Lab Code:	K9700452-007	K9700452-009	K9700452-011
Date Analyzed:	2/3/97	2/3/97	2/3/97

Analyte	EPA Method	MRL			
Cadmium	200.8	0.02	17.0	1.98	ND
Copper	6010A	10	ND	12	ND
Iron	6010A	20	72	63	ND
Lead	200.8	0.5	0.6	ND	ND
Manganese	6010A	5	888	180	ND
Silver	200.8	0.02	0.07	0.08	ND
Zinc	6010A	10	8740	1160	ND

Approved By: _____

Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-01-01
Sample Matrix: Water

Service Request: K9700452
Date Collected: 1/21-23/97
Date Received: 1/24/97
Date Extracted: 1/31-2/3/97

Dissolved Metals
Units: µg/L (ppb)

Sample Name:	00174	00176	00178
Lab Code:	K9700452-013	K9700452-015	K9700452-017
Date Analyzed:	2/3/97	2/3/97	2/3/97

Analyte	EPA Method	MRL			
Cadmium	200.8	0.02	0.66	0.66	5.03
Copper	6010A	10	ND	ND	13
Iron	6010A	20	6210	372	6090
Lead	200.8	0.5	1.2	ND	0.6
Manganese	6010A	5	1560	1110	1350
Silver	200.8	0.02	0.05	ND	ND
Zinc	6010A	10	723	229	1810

Approved By: _____

Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-01-01
Sample Matrix: Water

Service Request: K9700452
Date Collected: 1/21-23/97
Date Received: 1/24/97
Date Extracted: 1/31-2/3/97

Dissolved Metals
Units: µg/L (ppb)

Sample Name:	00180	00182	00184
Lab Code:	K9700452-019	K9700452-021	K9700452-023
Date Analyzed:	2/3/97	2/3/97	2/3/97

Analyte	EPA Method	MRL			
Cadmium	200.8	0.02	0.70	0.67	0.76
Copper	6010A	10	ND	ND	ND
Iron	6010A	20	141	145	80
Lead	200.8	0.5	ND	ND	ND
Manganese	6010A	5	269	257	259
Silver	200.8	0.02	<0.03(B)	ND	<0.03(B)
Zinc	6010A	10	178	164	173

B The MRL is elevated because of matrix interferences.

Approved By: _____

Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-01-01
Sample Matrix: Water

Service Request: K9700452
Date Collected: 1/21-23/97
Date Received: 1/24/97
Date Extracted: 1/31-2/3/97

Dissolved Metals
Units: µg/L (ppb)

Sample Name: 00186 **Method Blank**
Lab Code: K9700452-025 **K9700452-MB**
Date Analyzed: 2/3/97 **2/3/97**

Analyte	EPA Method	MRL		
Cadmium	200.8	0.02	0.74	ND
Copper	6010A	10	ND	ND
Iron	6010A	20	75	ND
Lead	200.8	0.5	ND	ND
Manganese	6010A	5	258	ND
Silver	200.8	0.02	<0.03(B)	ND
Zinc	6010A	10	170	ND

B The MRL is elevated because of matrix interferences.

Approved By: _____ **Date:** 2/7/97

Analytical Report

Service Request: K9700452
Date Collected: 1/21-23/97
Date Received: 1/24/97
Date Extracted: 2/3/97
Date Analyzed: 2/3/97

Sample Name	Lab Code	MRL	Result
00162	K9700452-001	0.2	444
00164	K9700452-003	0.2	695
00166	K9700452-005	0.2	184
00168	K9700452-007	0.2	1020
00170	K9700452-009	0.2	929
00172	K9700452-011	0.2	ND
00174	K9700452-013	0.2	700
00176	K9700452-015	0.2	421
00178	K9700452-017	0.2	256
00180	K9700452-019	0.2	226
00182	K9700452-021	0.2	212
00184	K9700452-023	0.2	217
00186	K9700452-025	0.2	216
Method Blank	K9700452-MB	0.2	0.2

Approved By: _____ Date: 2/7/97
 1AMRL/102594
 00452ICP.G/I - Sample (6) 2/6/97



ESA CONSULTANTS INC.

SAMPLE ANALYSIS REQUEST/CHAIN OF CUSTODY FORM

Samples sent to:

ABBIE SPEILMANN
COLUMBIA ANALYTICAL SERVICES
1317 S. 13th Ave
KELSO, WA 98626

FOR LAB USE

LAB ID _____

Send Analytical Results to:

ESA Consultants Inc.
 2637 Midpoint Drive, Suite F
 Fort Collins, Colorado 80525
 Attn: Todd Sullivan

Project Name: RICO POST-VCUP
 Project Number: 101 9601 060
 Contact Person: TODD SULLIVAN
 Telephone No.: (970) 484-3611

TAG NUMBER	CONTAINER/ PRESERVATIVE	ANALYSIS
00162	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00163	1L	TDS, TSS, SULFATE
00164	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00165	1L	TDS, TSS, SULFATE
00166	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00167	1L	TDS, TSS, SULFATE
00168	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00169	1L	TDS, TSS, SULFATE
00170	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00171	1L	TDS, TSS, SULFATE
00172	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00173	1L	TDS, TSS, SULFATE
00174	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00175	1L	TDS, TSS, SULFATE
00176	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00177	1L	TDS, TSS, SULFATE
00177 ^{rs}		

SAMPLES RELINQUISHED BY	SAMPLES RECEIVED BY	FORM NO.
Signature: <u>Todd Sullivan</u> Date: <u>1-23-97</u> Time: <u>1400</u> Signature: _____ Date: _____ Time: _____ Signature: _____ Date: _____ Time: _____	Signature: <u>Mary Cohen</u> Date: <u>1-24-97</u> Time: <u>16:00</u> Signature: _____ Date: _____ Time: _____ Signature: _____ Date: _____ Time: _____	



ESA CONSULTANTS INC.

K97-0452

SAMPLE ANALYSIS REQUEST/CHAIN OF CUSTODY FORM

Samples sent to:

ABBIE SPEILMANN
COLUMBIA ANALYTICAL SERVICES
1317 S. 13th Ave
KELSO, WA 98626

FOR LAB USE

LAB ID _____

Send Analytical Results to:

ESA Consultants Inc.
2637 Midpoint Drive, Suite F
Fort Collins, Colorado 80525
Attn: Todd Sullivan

Project Name: RICO POST-VCUP
Project Number: 101 9601 060
Contact Person: TODD SULLIVAN
Telephone No.: (970) 484-3611

TAG NUMBER	CONTAINER/ PRESERVATIVE	ANALYSIS
00178	HNO ₃	DISSOLVED METALS, HARDNESS
00179		TDS, TSS, SULFATE
00180	HNO ₃	DISSOLVED METALS, HARDNESS
00181		TDS, TSS, SULFATE
00182	HNO ₃	DISSOLVED METALS, HARDNESS
00183		TDS, TSS, SULFATE
00184	HNO ₃	DISSOLVED METALS, HARDNESS
00185		TDS, TSS, SULFATE
00186	HNO ₃	DISSOLVED METALS, HARDNESS
00187		TDS, TSS, SULFATE
	HNO ₃	DISSOLVED METALS, HARDNESS
		TDS, TSS, SULFATE
	HNO ₃	DISSOLVED METALS, HARDNESS
	TS 1-23-97	TDS, TSS, SULFATE
	HNO ₃	DISSOLVED METALS, HARDNESS
		TDS, TSS, SULFATE

SAMPLES RELINQUISHED BY			SAMPLES RECEIVED BY			FORM NO.
Signature: <u>Todd Sullivan</u>	Date: <u>1-23-97</u>	Time: <u>1400</u>	Signature: <u>Mary Colburn</u>	Date: <u>1-24-97</u>	Time: <u>10:00</u>	
Signature: _____	Date: _____	Time: _____	Signature: _____	Date: _____	Time: _____	
Signature: _____	Date: _____	Time: _____	Signature: _____	Date: _____	Time: _____	

D3 Spring Quarter 1997



May 14, 1997

Service Request No: K9702631

Laura Jones
PTI Environmental Services
4000 Kruse Way Place, Building Two, Suite 285
Lake Oswego, OR 97035

Re: RICO POST-VCUP

Dear Laura:

Enclosed are the results of the sample(s) submitted to our laboratory on April 21, 1997. For your reference, these analyses have been assigned our service request number K9702631.

All analyses were performed according to our laboratory's quality assurance program. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed.

Please call if you have any questions. My extension is 246.

Respectfully submitted,

Columbia Analytical Services, Inc.

A handwritten signature in cursive script, appearing to read "Abbie H. Spielman".

Abbie Spielman
Client Services Manager

AS/td

Page 1 of 204

cc: Todd Sullivan (ESA/Fort Collins, Colorado)

RICO SURFACE WATER SAMPLING SPRING QUARTER 1997

TAG NUMBER	SAMPLING LOCATION	DATE/TIME	ANALYSIS
00188	SVS-5	4-16-97/1130	DISS. METALS, HARDNESS
00189	SVS-5	4-16-97/1130	TDS, TSS, SULFATE
00190	SVS-12	4-16-97/1250	DISS. METALS, HARDNESS
00191	SVS-12	4-16-97/1250	TDS, TSS, SULFATE
00192	SVS-11	4-16-97/1400	DISS. METALS, HARDNESS
00193	SVS-11	4-16-97/1400	TDS, TSS, SULFATE
00194	SVS-8	4-16-97/1500	DISS. METALS, HARDNESS
00195	SVS-8	4-16-97/1500	TDS, TSS, SULFATE
00196	DR-16-SW	4-16-97/1730	DISS. METALS, HARDNESS
00197	DR-16-SW	4-16-97/1730	TDS, TSS, SULFATE
00198	DR-8-SW	4-16-97/1810	DISS. METALS, HARDNESS
00199	DR-8-SW	4-16-97/1810	TDS, TSS, SULFATE
00200	DR-8-SW (DUPE)	4-16-97/1810	DISS. METALS, HARDNESS
00201	DR-8-SW (DUPE)	4-16-97/1810	TDS, TSS, SULFATE
00202	DR-1-SW	4-17-97/0900	DISS. METALS, HARDNESS
00203	DR-1-SW	4-17-97/0900	TDS, TSS, SULFATE
00204	DR-9-SW	4-17-97/1120	DISS. METALS, HARDNESS
00205	DR-9-SW	4-17-97/1120	TDS, TSS, SULFATE
00206	DR-10-SW	4-17-97/1140	DISS. METALS, HARDNESS
00207	DR-10-SW	4-17-97/1140	TDS, TSS, SULFATE
00208	DR-6-SW	4-17-97/1320	DISS. METALS, HARDNESS
00209	DR-6-SW	4-17-97/1320	TDS, TSS, SULFATE
00210	DR-17-SW	4-17-97/1340	DISS. METALS, HARDNESS
00211	DR-17-SW	4-17-97/1340	TDS, TSS, SULFATE
00212	DR-7-SW	4-17-97/1425	DISS. METALS, HARDNESS
00213	DR-7-SW	4-17-97/1425	TDS, TSS, SULFATE
00214	DR-4-SW	4-18-97/0900	DISS. METALS, HARDNESS
00215	DR-4-SW	4-18-97/0900	TDS, TSS, SULFATE
00216	DR-18-SW	4-18-97/1045	DISS. METALS, HARDNESS
00217	DR-18-SW	4-18-97/1045	TDS, TSS, SULFATE
00218	DR-2-SW	4-18-97/1220	DISS. METALS, HARDNESS
00219	DR-2-SW	4-18-97/1220	TDS, TSS, SULFATE
00220*	DR-2-SW (BLANK)	4-18-97/1220	DISS. METALS, HARDNESS
00221**	DR-2-SW (BLANK)	4-18-97/1220	DISS. METALS, HARDNESS
00222***	DR-2-SW (BLANK)	4-18-97/1220	TDS, TSS, SULFATE

* Filter blank using peristaltic pump and cartridge filters

** Filter blank using hand pump and vacuum filters

*** Bottle blank

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP
Sample Matrix: Water

Service Request: K9702631
Date Collected: 4/16-18/97
Date Received: 4/21/97
Date Extracted: NA

Inorganic Parameters
Units: mg/L (ppm)

Analyte:	Solids, Total Dissolved (TDS)	Solids, Total Suspended (TSS)	Sulfate
EPA Method:	160.1	160.2	300.0
Method Reporting Limit:	5	5	0.2
Date Analyzed:	4/22,23/97	4/22,23/97	5/6/97

Sample Name	Lab Code			
00189	K9702631-002	141	ND	16
00191	K9702631-004	1010	6	550
00193	K9702631-006	1050	11	570
00195	K9702631-008	236	ND	72
00197	K9702631-010	967	ND	250
00199	K9702631-012	1060	ND	300
00201	K9702631-014	1150	ND	290
00203	K9702631-016	478	32	230
00205	K9702631-018	357	ND	95
00207	K9702631-020	1080	ND	320
00209	K9702631-022	238	ND	40
00211	K9702631-024	124	ND	18
00213	K9702631-026	735	ND	120
00215	K9702631-028	241	ND	62
00217	K9702631-030	182	ND	56
00219	K9702631-032	178	ND	55
00222	K9702631-034	ND	ND	ND
Method Blank	K9702631-MB	ND	ND	ND

Approved By: 

Date: 5/7/97

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP
Sample Matrix: Water

Service Request: K9702631
Date Collected: 4/16-18/97
Date Received: 4/21/97
Date Extracted: 4/30/97

Dissolved Metals
Units: µg/L (ppb)

Sample Name:	00188	00190	00192
Lab Code:	K9702631-001	K9702631-003	K9702631-005
Date Analyzed:	5/1/97	5/1/97	5/1/97

Analyte	EPA Method	MRL			
Cadmium	200.8	0.02	2.32	0.76	1.94
Copper	6010A	10	ND	ND	ND
Iron	6010A	20	27	12200	2100
Lead	200.8	0.5	ND	1.14	ND
Manganese	6010A	5	82	8010	6260
Silver	200.8	0.02	ND	ND	ND
Zinc	6010A	10	358	6690	4170

Approved By: _____

Date: 6/6/97

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP
Sample Matrix: Water

Service Request: K9702631
Date Collected: 4/16-18/97
Date Received: 4/21/97
Date Extracted: 4/30/97

Dissolved Metals
Units: µg/L (ppb)

Sample Name:	00194	00196	00198
Lab Code:	K9702631-007	K9702631-009	K9702631-011
Date Analyzed:	5/1/97	5/1/97	5/1/97

Analyte	EPA Method	MRL			
Cadmium	200.8	0.02	2.16	13.6	2.17
Copper	6010A	10	ND	ND	17
Iron	6010A	20	40	62	49
Lead	200.8	0.5	ND	ND	ND
Manganese	6010A	5	403	1270	396
Silver	200.8	0.02	ND	ND	0.03
Zinc	6010A	10	633	7620	1200

Approved By: _____

Date: 6/6/97

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP
Sample Matrix: Water

Service Request: K9702631
Date Collected: 4/16-18/97
Date Received: 4/21/97
Date Extracted: 4/30/97

Dissolved Metals
Units: µg/L (ppb)

Sample Name:	00200	00202	00204
Lab Code:	K9702631-013	K9702631-015	K9702631-017
Date Analyzed:	5/1/97	5/1/97	5/1/97

Analyte	EPA Method	MRL			
Cadmium	200.8	0.02	2.08	10.7	0.68
Copper	6010A	10	19	61	ND
Iron	6010A	20	55	12900	147
Lead	200.8	0.5	ND	2.75	ND
Manganese	6010A	5	412	3380	621
Silver	200.8	0.02	0.03	ND	ND
Zinc	6010A	10	1210	4390	248

Approved By: _____

Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP
Sample Matrix: Water

Service Request: K9702631
Date Collected: 4/16-18/97
Date Received: 4/21/97
Date Extracted: 4/30/97

Dissolved Metals
Units: µg/L (ppb)

Sample Name:	00206	00208	00210
Lab Code:	K9702631-019	K9702631-021	K9702631-023
Date Analyzed:	5/1/97	5/1/97	5/1/97

Analyte	EPA Method	MRL			
Cadmium	200.8	0.02	1.52	0.77	0.60
Copper	6010A	10	10	ND	ND
Iron	6010A	20	52	55	ND
Lead	200.8	0.5	ND	0.55	0.88
Manganese	6010A	5	194	181	ND
Silver	200.8	0.02	ND	ND	ND
Zinc	6010A	10	775	191	103

Approved By: _____

Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP
Sample Matrix: Water

Service Request: K9702631
Date Collected: 4/16-18/97
Date Received: 4/21/97
Date Extracted: 4/30/97

Dissolved Metals
Units: µg/L (ppb)

Sample Name:	00212	00214	00216
Lab Code:	K9702631-025	K9702631-027	K9702631-029
Date Analyzed:	5/1/97	5/1/97	5/1/97

Analyte	EPA Method	MRL			
Cadmium	200.8	0.02	1.29	0.53	0.52
Copper	6010A	10	ND	ND	ND
Iron	6010A	20	2590	108	122
Lead	200.8	0.5	6.62	ND	ND
Manganese	6010A	5	890	139	127
Silver	200.8	0.02	ND	ND	ND
Zinc	6010A	10	501	141	134

Approved By: _____

Date: 6/6/97

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP
Sample Matrix: Water

Service Request: K9702631
Date Collected: 4/16-18/97
Date Received: 4/21/97
Date Extracted: 4/30/97

Dissolved Metals
Units: µg/L (ppb)

Sample Name:	00218	00220	00221
Lab Code:	K9702631-031	K9702631-033	K9702631-035
Date Analyzed:	5/1/97	5/1/97	5/1/97

Analyte	EPA Method	MRL			
Cadmium	200.8	0.02	0.57	ND	ND
Copper	6010A	10	ND	ND	ND
Iron	6010A	20	56	ND	ND
Lead	200.8	0.5	ND	ND	ND
Manganese	6010A	5	109	ND	ND
Silver	200.8	0.02	ND	ND	ND
Zinc	6010A	10	128	ND	ND

Approved By: _____

Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP
Sample Matrix: Water

Service Request: K9702631
Date Collected: NA
Date Received: NA
Date Extracted: 4/30/97

Dissolved Metals
Units: µg/L (ppb)

Sample Name: Method Blank
Lab Code: K9702631-MB
Date Analyzed: 5/1/97

Analyte	EPA Method	MRL	
Cadmium	200.8	0.02	ND
Copper	6010A	10	ND
Iron	6010A	20	ND
Lead	200.8	0.5	ND
Manganese	6010A	5	ND
Silver	200.8	0.02	ND
Zinc	6010A	10	ND

Approved By: _____

Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP
Sample Matrix: Water

Service Request: K9702631
Date Collected: 4/16-18/97
Date Received: 4/21/97
Date Extracted: 4/30/97
Date Analyzed: 5/1/97

Hardness, as CaCO_3
EPA Method 6010A/ SM Method 2340B
Units: mg/L (ppm)

Sample Name	Lab Code	MRL	Result
00188	K9702631-001	0.2	108
00190	K9702631-003	0.2	703
00192	K9702631-005	0.2	761
00194	K9702631-007	0.2	174
00196	K9702631-009	0.2	1010
00198	K9702631-011	0.2	930
00200	K9702631-013	0.2	958
00202	K9702631-015	0.2	345
00204	K9702631-017	0.2	310
00206	K9702631-019	0.2	903
00208	K9702631-021	0.2	201
00210	K9702631-023	0.2	80.1
00212	K9702631-025	0.2	644
00214	K9702631-027	0.2	174
00216	K9702631-029	0.2	160
00218	K9702631-031	0.2	163
00220	K9702631-033	0.2	0.5
00221	K9702631-035	0.2	ND
Method Blank	K9702631-MB	0.2	ND

SM *Standard Method for the Examination of Water and Wastewater*, 19th Ed..

Approved By: _____

Date: _____

5/5/97



ESA CONSULTANTS INC.

SAMPLE ANALYSIS REQUEST/CHAIN OF CUSTODY FORM

Samples sent to:

ABBIE SPEILMANN
COLUMBIA ANALYTICAL SERVICES
1317 S. 13th Ave
KELSO, WA 98626

FOR LAB USE
LAB ID K97-21031

Send Analytical Results to:

ESA Consultants Inc.
2637 Midpoint Drive, Suite F
Fort Collins, Colorado 80525
Attn: Todd Sullivan

Project Name: RICO POST-VCUP
Project Number: 101 9601 060
Contact Person: TODD SULLIVAN
Telephone No.: (970) 484-3611

TAG NUMBER	CONTAINER/ PRESERVATIVE	ANALYSIS
00188	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00189	1L	TDS, TSS, SULFATE
00190	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00191	1L	TDS, TSS, SULFATE
00192	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00193	1L	TDS, TSS, SULFATE
00194	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00195	1L	TDS, TSS, SULFATE
00196	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00197	1L	TDS, TSS, SULFATE
00198	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00199	1L	TDS, TSS, SULFATE
00200	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00201	1L	TDS, TSS, SULFATE
00202	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00203	1L	TDS, TSS, SULFATE

SAMPLES RELINQUISHED BY	SAMPLES RECEIVED BY	FORM NO.
Signature: <u>Todd Sullivan</u> Date: <u>4-18-97</u> Time: <u>1600</u>	Signature: <u>[Signature]</u> Date: <u>4-21-97</u> Time: <u>0930</u>	
Signature: _____ Date: _____ Time: _____	Signature: _____ Date: _____ Time: _____	
Signature: _____ Date: _____ Time: _____	Signature: _____ Date: _____ Time: _____	



ESA CONSULTANTS INC.

SAMPLE ANALYSIS REQUEST/CHAIN OF CUSTODY FORM

Samples sent to:

ABBIE SPEILMANN
COLUMBIA ANALYTICAL SERVICES
1317 S. 13th Ave
KELSO, WA 98626

FOR LAB USE
LAB ID K97-2631

Send Analytical Results to:

ESA Consultants Inc.
2637 Midpoint Drive, Suite F
Fort Collins, Colorado 80525
Attn: Todd Sullivan

Project Name: RICO POST-VCUP
Project Number: 101 9601 060
Contact Person: TODD SULLIVAN
Telephone No.: (970) 484-3611

TAG NUMBER	CONTAINER/ PRESERVATIVE	ANALYSIS
00204	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00205	1L	TDS, TSS, SULFATE
00206	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00207	1L	TDS, TSS, SULFATE
00208	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00209	1L	TDS, TSS, SULFATE
00210	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00211	1L	TDS, TSS, SULFATE
00212	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00213	1L	TDS, TSS, SULFATE
00214	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00215	1L	TDS, TSS, SULFATE
00216	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00217	1L	TDS, TSS, SULFATE
00218	500ml HNO ₃	DISSOLVED METALS, HARDNESS
00219	1L	TDS, TSS, SULFATE

SAMPLES RELINQUISHED BY		SAMPLES RECEIVED BY		FORM NO.
Signature: <u>Todd Sullivan</u>	Date: <u>4-18-97</u> Time: <u>1600</u>	Signature: <u>[Signature]</u>	Date: <u>4-21-97</u> Time: <u>0930</u>	
Signature: _____	Date: _____ Time: _____	Signature: _____	Date: _____ Time: _____	
Signature: _____	Date: _____ Time: _____	Signature: _____	Date: _____ Time: _____	



ESA CONSULTANTS INC.

SAMPLE ANALYSIS REQUEST/CHAIN OF CUSTODY FORM

Samples sent to:

ABBIE SPEILMANN
COLUMBIA ANALYTICAL SERVICES
1317 S. 13th Ave
KELSO, WA 98626

FOR LAB USE
LAB ID KA1-2631

Send Analytical Results to:

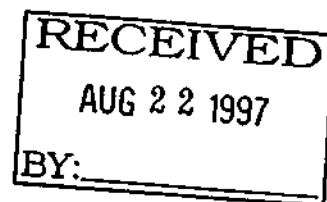
ESA Consultants Inc.
2637 Midpoint Drive, Suite F
Fort Collins, Colorado 80525
Attn: Todd Sullivan

Project Name: RICO POST-VCUP
Project Number: 101 9601 060
Contact Person: TODD SULLIVAN
Telephone No.: (970) 484-3611

TAG NUMBER	CONTAINER/ PRESERVATIVE	ANALYSIS
00220	HNO ₃	DISSOLVED METALS, HARDNESS
00222		TDS, TSS, SULFATE
00221	HNO ₃	DISSOLVED METALS, HARDNESS
		TDS, TSS, SULFATE
	HNO ₃	DISSOLVED METALS, HARDNESS
		TDS, TSS, SULFATE
	HNO ₃	DISSOLVED METALS, HARDNESS
		TDS, TSS, SULFATE
	HNO ₃	DISSOLVED METALS, HARDNESS
		TDS, TSS, SULFATE
	HNO ₃	DISSOLVED METALS, HARDNESS
		TDS, TSS, SULFATE
	HNO ₃	DISSOLVED METALS, HARDNESS
		TDS, TSS, SULFATE
	HNO ₃	DISSOLVED METALS, HARDNESS
		TDS, TSS, SULFATE

SAMPLES RELINQUISHED BY		SAMPLES RECEIVED BY		FORM NO.
Signature: <u>Todd Sullivan</u>	Date: <u>4/18/97</u> Time: <u>1600</u>	Signature: <u>[Signature]</u>	Date: <u>4/19/97</u> Time: <u>0930</u>	
Signature: _____	Date: _____ Time: _____	Signature: _____	Date: _____ Time: _____	
Signature: _____	Date: _____ Time: _____	Signature: _____	Date: _____ Time: _____	

D4 Summer Quarter 1997



August 18, 1997

Service Request No: K9705429

Laura Jones
PTI Environmental Services, Inc.
4000 Kruse Way Place, Building Two, Suite 285
Lake Oswego, OR 97035

Re: RICO POST-VCUP/CB41-0101

Dear Laura:

Enclosed are the results of the sample(s) submitted to our laboratory on August 1 through August 2, 1997. Preliminary results were transmitted via facsimile on August 15 and 18, 1997. For your reference, these analyses have been assigned our service request number K9705429.

All analyses were performed according to our laboratory's quality assurance program. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed.

Please call if you have any questions. My extension is 246.

Respectfully submitted,

Columbia Analytical Services, Inc.

A handwritten signature in cursive script that reads "Abbie Spielman".

Abbie Spielman
Client Services Manager

AS/sm

Page 1 of

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cc: Todd Sullivan, ESA Consultants, Inc. (Fort Collins, CO)

RICO SURFACE WATER SAMPLING SUMMER QUARTER 1997

TAG NUMBER	SAMPLING LOCATION	DATE/TIME	ANALYSIS
00221	SVS-5	7-29-97/1030	DISS. METALS, HARDNESS
00222	SVS-5	7-29-97/1030	TDS, TSS, SULFATE
00223	SVS-8	7-29-97/1222	DISS. METALS, HARDNESS
00224	SVS-8	7-29-97/1222	TDS, TSS, SULFATE
00225	SVS-8	7-29-97/1222	DISS. METALS, HARDNESS (DUPE)
00226	SVS-8	7-29-97/1222	TDS, TSS, SULFATE (DUPE)
00227	SVS-11	7-29-97/1355	DISS. METALS, HARDNESS
00228	SVS-11	7-29-97/1355	TDS, TSS, SULFATE
00229	SVS-12	7-29-97/1510	DISS. METALS, HARDNESS
00230	SVS-12	7-29-97/1510	TDS, TSS, SULFATE
00231	SVS-12	7-29-97/1510	CYANIDE
00232	SVS-12	7-29-97/1510	CYANIDE (DUPE)
00233	DR-16-SW	7-30-97/0820	DISS. METALS, HARDNESS
00234	DR-16-SW	7-30-97/0820	TDS, TSS, SULFATE
00235	DR-8-SW	7-30-97/1030	DISS. METALS, HARDNESS
00236	DR-8-SW	7-30-97/1030	TDS, TSS, SULFATE
00237	DR-2-SW	7-30-97/1300	DISS. METALS, HARDNESS
00238	DR-2-SW	7-30-97/1300	TDS, TSS, SULFATE
00239	DR-18-SW	7-30-97/1430	DISS. METALS, HARDNESS (BLANK)*
00240	DR-18-SW	7-30-97/1430	TDS, TSS, SULFATE (BLANK)**
00241	DR-18-SW	7-30-97/1430	DISS. METALS, HARDNESS
00242	DR-18-SW	7-30-97/1430	TDS, TSS, SULFATE
00243	DR-4-SW	7-30-97/1515	DISS. METALS, HARDNESS
00244	DR-4-SW	7-30-97/1515	TDS, TSS, SULFATE
00245	DR-1-SW	7-30-97/1550	DISS. METALS, HARDNESS
00246	DR-1-SW	7-30-97/1550	TDS, TSS, SULFATE
00247	DR-10-SW	7-31-97/0915	DISS. METALS, HARDNESS
00248	DR-10-SW	7-31-97/0915	TDS, TSS, SULFATE
00249	DR-6-SW	7-31-97/1040	DISS. METALS, HARDNESS
00250	DR-6-SW	7-31-97/1040	TDS, TSS, SULFATE
00251	DR-15a-SW	7-31-97/1100	DISS. METALS, HARDNESS
00252	DR-15a-SW	7-31-97/1100	TDS, TSS, SULFATE
00253	DR-7-SW	7-31-97/1130	DISS. METALS, HARDNESS
00254	DR-7-SW	7-31-97/1130	TDS, TSS, SULFATE

* Filter blank using peristaltic pump and cartridge filters

** Bottle blank

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-0101
Sample Matrix: Water

Service Request: K9705429
Date Collected: 7/30/97
Date Received: 8/1/97
Date Extracted: NA

Inorganic Parameters Units: mg/L (ppm)

Analyte:	Solids, Total Suspended (TSS)	Solids, Total Dissolved (TDS)	Sulfate
EPA Method:	160.2	160.1	300.0
Method Reporting Limit:	5	5	0.2
Date Analyzed:	8/5,6/97	8/5,6/97	8/12/97

Sample Name

Lab Code

00234	K9705429-001	8	840	200
00238	K9705429-004	48	142	26
00244	K9705429-005	159	125	25
00246	K9705429-007	140	122	20
00248	K9705429-009	ND	983	290
00250	K9705429-011	ND	169	26
00252	K9705429-013	ND	116	15
00254	K9705429-015	ND	686	140
00222	K9705429-017	ND	112	14
00224	K9705429-019	ND	178	36
00226	K9705429-021	ND	162	35
00228	K9705429-023	ND	1170	690
00230	K9705429-025	10	1090	480
00236	K9705429-029	ND	1080	280
00240	K9705429-031	ND	18	ND
00242	K9705429-033	168	121	23
Method Blank 1	K9705429-MB1	ND	ND	ND
Method Blank 2	K9705429-MB2	ND	ND	-

Approved By: _____

Date: 8/18/97

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-0101
Sample Matrix: Water

Service Request: K9705429
Date Collected: 7/29/97
Date Received: 8/1/97
Date Extracted: NA
Date Analyzed: 8/12/97

Cyanide, Total
EPA Method 335.2
Units: mg/L (ppm)

Sample Name	Lab Code	MRL	Result
00231	K9705429-026	0.01	ND
00232	K9705429-027	0.01	0.02
Method Blank	K9705429-MB	0.01	ND

Approved By: asp Date: 8/18/97

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Service, Inc.
Project: RICO POST-VCUP/CB41-0101
Sample Matrix: Water

Service Request: K9705429
Date Collected: 7/29-31/97
Date Received: 8/1/97
Date Extracted: 8/7/97
Date Analyzed: 8/13/97

Hardness, as CaCO₃
EPA Method 6010A/ SM Method 2340B
Units: mg/L (ppm)

Sample Name	Lab Code	MRL	Result
00235	K9705429-002	0.2	858
00237	K9705429-003	0.2	83.0
00245	K9705429-006	0.2	67.2
00247	K9705429-008	0.2	760
00249	K9705429-010	0.2	122
00251	K9705429-012	0.2	65.3
00253	K9705429-014	0.2	599
00221	K9705429-016	0.2	87.2
00223	K9705429-018	0.2	112
00225	K9705429-020	0.2	110
00227	K9705429-022	0.2	792
00229	K9705429-024	0.2	710
00233	K9705429-028	0.2	1030
00239	K9705429-030	0.2	0.3
00241	K9705429-032	0.2	74.0
00243	K9705429-034	0.2	79.0
Method Blank	K9705429-MB	0.2	ND

SM *Standard Method for the Examination of Water and Wastewater, 19th Ed.,*

Approved By: _____

Date: 8/15/97

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-0101
Sample Matrix: Water

Service Request: K9705249
Date Collected: 7/29-31/97
Date Received: 8/1/97
Date Extracted: 8/7/97

Dissolved Metals
 Units: µg/L (ppb)

Sample Name:	00235	00237	00245
Lab Code:	K9705429-002	K9705429-003	K9705429-006
Date Analyzed:	8/13/97	8/13/97	8/13/97

Analyte	EPA Method	MRL			
Cadmium	200.8	0.1	3.5	0.3	0.2
Copper	6010A	10	21	ND	ND
Iron	6010A	20	36	53	98
Lead	200.8	0.5	ND	ND	ND
Manganese	6010A	5	357	62	66
Silver	200.8	0.1	ND	ND	ND
Zinc	6010A	10	1480	90	65

Approved By: _____

4c

Date: _____

8/15/97

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
 Project: RICO POST-VCUP/CB41-0101
 Sample Matrix: Water

Service Request: K9705249
 Date Collected: 7/29-31/97
 Date Received: 8/1/97
 Date Extracted: 8/7/97

Dissolved Metals
 Units: µg/L (ppb)

Sample Name:	00247	00249	00251
Lab Code:	K9705429-008	K9705429-010	K9705429-012
Date Analyzed:	8/13/97	8/13/97	8/13/97

Analyte	EPA Method	MRL			
Cadmium	200.8	0.1	1.7	0.5	0.5
Copper	6010A	10	ND	ND	ND
Iron	6010A	20	101	126	ND
Lead	200.8	0.5	ND	0.7	0.8
Manganese	6010A	5	366	209	ND
Silver	200.8	0.1	ND	ND	ND
Zinc	6010A	10	626	127	76

Approved By: _____

Date: _____

8/15/97

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
 Project: RICO POST-VCUP/CB41-0101
 Sample Matrix: Water

Service Request: K9705249
 Date Collected: 7/29-31/97
 Date Received: 8/1/97
 Date Extracted: 8/7/97

Dissolved Metals
 Units: µg/L (ppb)

Sample Name:	00253	00221	00223
Lab Code:	K9705429-014	K9705429-016	K9705429-018
Date Analyzed:	8/13/97	8/13/97	8/13/97

Analyte	EPA Method	MRL			
Cadmium	200.8	0.1	1.5	2.1	1.8
Copper	6010A	10	ND	ND	ND
Iron	6010A	20	3120	341	101
Lead	200.8	0.5	4.2	0.7	0.6
Manganese	6010A	5	963	143	235
Silver	200.8	0.1	ND	ND	ND
Zinc	6010A	10	567	353	347

Approved By: _____

Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-0101
Sample Matrix: Water

Service Request: K9705249
Date Collected: 7/29-31/97
Date Received: 8/1/97
Date Extracted: 8/7/97

Dissolved Metals
Units: µg/L (ppb)

Sample Name:	00225	00227	00229
Lab Code:	K9705429-020	K9705429-022	K9705429-024
Date Analyzed:	8/13/97	8/13/97	8/13/97

Analyte	EPA Method	MRL			
Cadmium	200.8	0.1	1.8	1.9	0.5
Copper	6010A	10	ND	ND	ND
Iron	6010A	20	84	2260	11900
Lead	200.8	0.5	ND	ND	5.9
Manganese	6010A	5	231	6690	7250
Silver	200.8	0.1	ND	ND	ND
Zinc	6010A	10	340	3620	5890

Approved By: _____

Date: 8/15/97

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
 Project: RICO POST-VCUP/CB41-0101
 Sample Matrix: Water

Service Request: K9705249
 Date Collected: 7/29-31/97
 Date Received: 8/1/97
 Date Extracted: 8/7/97

Dissolved Metals
 Units: µg/L (ppb)

Sample Name:	00233	00239	00241
Lab Code:	K9705429-028	K9705429-030	K9705429-032
Date Analyzed:	8/13/97	8/13/97	8/13/97

Analyte	EPA Method	MRL			
Cadmium	200.8	0.1	15.9	ND	ND
Copper	6010A	10	ND	ND	ND
Iron	6010A	20	52	ND	68
Lead	200.8	0.5	ND	ND	ND
Manganese	6010A	5	1930	ND	52
Silver	200.8	0.1	ND	ND	ND
Zinc	6010A	10	7690	ND	41

Approved By: _____

Date: _____

8/15/97

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-0101
Sample Matrix: Water

Service Request: K9705249
Date Collected: 7/29-31/97
Date Received: 8/1/97
Date Extracted: 8/7/97

Dissolved Metals
Units: µg/L (ppb)

Sample Name: 00243 **Method Blank**
Lab Code: K9705429-034 **K9705429-MB**
Date Analyzed: 8/13/97 **8/13/97**

Analyte	EPA		MRL	
	Method			
Cadmium	200.8	0.1	ND	ND
Copper	6010A	10	ND	ND
Iron	6010A	20	62	ND
Lead	200.8	0.5	ND	ND
Manganese	6010A	5	48	ND
Silver	200.8	0.1	ND	ND
Zinc	6010A	10	36	ND

Approved By: _____ *AL* **Date:** 8/15/97



ESA CONSULTANTS INC.

SAMPLE ANALYSIS REQUEST/CHAIN OF CUSTODY FORM

Samples sent to:

ABBIE SPEILMANN
COLUMBIA ANALYTICAL SERVICES
1317 S. 13th Ave
Kelso, WA 98626

FOR LAB USE

LAB ID _____

Send Analytical Results to:

ESA Consultants Inc.
2637 Midpoint Drive, Suite F
Fort Collins, Colorado 80525
Attn: Todd Sullivan

Project Name: Rico
Project Number: 101 9601 060
Contact Person: TODD SULLIVAN
Telephone No.: (970) 484 3611

TAG NUMBER	CONTAINER/ PRESERVATIVE	ANALYSIS
221 7/29/97	500ml pl. / HNO ₃	Diss. Metals, Hardness
222	1L pl.	TDS, TSS, SO ₄
223	500ml pl. / HNO ₃	Diss. Metals, Hardness
224	1L pl.	TDS, TSS, SO ₄
225	500ml pl. / HNO ₃	Diss. Metals, Hardness
226	1L pl.	TDS, TSS, SO ₄
227	500ml pl. / HNO ₃	Diss. Metals, Hardness
228	1L pl.	TDS, TSS, SO ₄
229	500ml pl. / HNO ₃	Diss. Metals, Hardness
230	1L pl.	TDS, TSS, SO ₄
231	1L pl. / NaOH	Cyanide
232	1L pl. / NaOH	Cyanide
233 7/30/97	500ml pl. / HNO ₃	Diss. Metals, Hardness
234	1L pl.	TDS, TSS, SO ₄
235	500ml pl. / HNO ₃	Diss. Metals, Hardness
236	1L pl.	TDS, TSS, SO ₄
237	500ml pl. / HNO ₃	Diss. Metals, Hardness

SAMPLES RELINQUISHED BY			SAMPLES RECEIVED BY			FORM NO.
Signature: <u>Todd Sullivan</u>	Date: <u>7/31/97</u>	Time: <u>1600</u>	Signature: _____	Date: _____	Time: _____	
Signature: _____	Date: _____	Time: _____	Signature: _____	Date: _____	Time: _____	
Signature: _____	Date: _____	Time: _____	Signature: _____	Date: _____	Time: _____	



ESA CONSULTANTS INC.

SAMPLE ANALYSIS REQUEST/CHAIN OF CUSTODY FORM

Samples sent to:

ABBIE SPELMANN
COLUMBIA ANALYTICAL SERVICES
1317 S. 13th Ave
Kelso WA 98626

FOR LAB USE

LAB ID _____

Send Analytical Results to:

ESA Consultants Inc.
 2637 Midpoint Drive, Suite F
 Fort Collins, Colorado 80525
 Attn: Todd Sullivan

Project Name: RICO
 Project Number: 101 9601 060
 Contact Person: TODD SULLIVAN
 Telephone No.: 970 484-3611

TAG NUMBER / Date	CONTAINER/ PRESERVATIVE	ANALYSIS
238 7/21/97	1L pl.	TDS TSS SO ₄
239	500 ml pl. HNO ₃	Diss. Metals, Hardness
240	1L pl.	TDS TSS SO ₄
241	500 ml pl. HNO ₃	Diss. Metals Hardness
242	1L pl.	TDS TSS SO ₄
243	500 ml HNO ₃	Diss. Metals Hardness
244	1L pl.	TDS TSS SO ₄
245	500 ml pl HNO ₃	Diss. Metals Hardness
246 ↓	1L pl.	TDS TSS SO ₄
247 7/21/97	500 ml pl HNO ₃	Diss. Metals Hardness
248	1L pl.	TDS TSS SO ₄
249	500 ml pl. HNO ₃	Diss. Metals, Hardness
250	1L pl.	TDS TSS SO ₄
251	500 ml pl HNO ₃	Diss. Metals Hardness
252	1L pl.	TDS TSS SO ₄
253	500 ml pl HNO ₃	Diss. Metals Hardness
254 ↓	1L pl.	TDS TSS SO ₄

SAMPLES RELINQUISHED BY	SAMPLES RECEIVED BY	FORM NO.
Signature: <u>Todd Sullivan</u> Date: <u>7/21/97</u> Time: <u>1000</u>	Signature: _____ Date: _____ Time: _____	
Signature: _____ Date: _____ Time: _____	Signature: _____ Date: _____ Time: _____	
Signature: _____ Date: _____ Time: _____	Signature: _____ Date: _____ Time: _____	

APPENDIX E

QA/QC REPORTS

- E1 Quality Assurance Review
 Summary**
- E2 Quarterly Data Validation
 Summary Reports**
- E3 Laboratory QA/QC Reports**

**E1 Quality Assurance Review
Summary**

QUALITY ASSURANCE REVIEW SUMMARY

INTRODUCTION

A quality assurance review of laboratory data was completed for ESA Consultants, Inc. and ARCO Environmental Remediation by PTI Environmental Services for the analysis of metals, cyanide, conventional parameters, and tetrachloroethene (PCE). The data are associated with surface water samples collected during the fall (October 1996), winter (January 1997), spring (April 1997), and summer (July 1997) quarterly sampling events conducted on Silver Creek and Dolores River corridor near Rico, Colorado. Data quality was assessed in terms of general method-specific quality control limits and guidance specified by U.S. Environmental Protection Agency (EPA) *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (U.S. EPA 1994a) and the EPA *Contract Laboratory Program National Functional Guidelines for Organic Data Review* (U.S. EPA 1994b). The sample set, overall data quality, and results for the field quality control samples are summarized below.

Data reported by the laboratory are acceptable. Qualifier codes have been added to some of the accepted results to indicate minor variation in the quality control results that could affect the bias or precision of the reported value. All of the data reported for these sampling events are acceptable and considered usable for data interpretation. Analytical results and associated data qualifiers for the natural samples are presented in Table 1.

SAMPLE SET

Fall Quarterly Sampling Event

The sample set consisted of 13 surface water samples, four field duplicate samples, one bottle blank, and one filter blank. All analyses were conducted by Columbia Analytical Services, Inc. (Kelso, Washington). The samples were analyzed for dissolved metals (cadmium, copper, iron, lead, manganese, silver, and zinc), total dissolved solids (TDS), total suspended solids (TSS), sulfate, and hardness (as calcium carbonate). In addition, one surface water sample was analyzed for dissolved mercury; two surface water samples and one field duplicate sample were analyzed for total cyanide; and one surface water sample and four field duplicate samples were analyzed for PCE.

TABLE 1. RICO SAMPLING RESULTS SUMMARY 1997

Station	Date	Time	Field Rep.	Dissolved Metals (µg/L)								Tetra-chloro-ethene (µg/L)	Total Cyanide (mg/L)	Hardness (mg/L)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Sulfate (mg/L)
				Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc						
FALL QUARTER 1996																	
DR-1-SW	10/23/96	15:50		5.32	15	6090	1.09	1660		0.02 U	1950		0.01 U	214	296	15	130
DR-2-SW	10/24/96	11:15		0.59	10 U	57	0.12 U	172		0.02 U	123			169	228	5 U	80
DR-4-SW	10/24/96	9:00		0.53	10 U	112	0.12 U	175		0.02 U	124			171	233	5	78
DR-6-SW	10/23/96	10:40		0.87	10 U	51	0.35	183		0.02 U	224			189	233	5 U	55
DR-7-SW	10/23/96	9:15		0.72	10 U	8370	5.60	1700		0.02 U	883			738	910	5 U	200
DR-8-SW	10/23/96	14:45		1.96	14	59	0.18 U	203	0.2 U	0.02 U	1300			1020	1210	5 U	280
DR-9-SW	10/23/96	11:50		0.61	10 U	247	0.11 U	854		0.02 U	168			433	576	5 U	200
DR-16-SW	10/23/96	14:00		15.0	10 U	63	2.38	811		0.02 U	9080			1020	1350	5 U	390
DR-18-SW	10/24/96	10:15		0.52	10 U	107	0.12 U	180		0.02 U	123			172	234	5 U	90
SVS-5	10/22/96	12:01		3.44	14	156	2.65	138		0.02 U	677			114	159	5 U	24
SVS-8	10/22/96	14:15		2.28	10 U	141	0.88	392		0.02 U	738			151	190	6	64
SVS-11	10/22/96	15:05		2.12	10 U	5080	0.04 U	6880		0.02 U	5410			618	832	26	510
SVS-12	10/22/96	16:25	1	3.45	10 U	5880	1.02	4990		0.02 U	5530	0.5 U	0.01 U	533	760	5 U	390
SVS-12	10/22/96	16:25	2	3.48	10 U	6010	0.92	5100		0.02 U	5640	0.5 U	0.01 U	545	751	6	410
SVS-12	10/22/96	16:25	3									0.5 U					
SVS-12	10/22/96	16:25	4									0.5 U					
SVS-12	10/22/96	16:25	5									0.5 U					
Bottle Blank	10/23/96	14:00													5 U	5 U	0.2 U
Filter Blank	10/23/96	14:00		0.03	10 U	20 U	0.06	5 U		0.02 U	10 U			0.2 U			
WINTER QUARTER 1997																	
DR-1-SW	1/22/97	14:30		5.03	13	6090	0.6	1350		0.02 U	1810			256	363	16	150
DR-2-SW	1/23/97	10:30		0.76	10 U	80	0.5 U	259		0.03 ^a U	173			217	301	5 U	100
DR-2-SW	1/23/97	10:30	A	0.74	10 U	75	0.5 U	258		0.03 ^a U	170			216	283	5 U	100
DR-4-SW	1/23/97	9:00		0.70	10 U	141	0.5 U	269		0.03 ^a U	178			226	299	5 U	110
DR-7-SW	1/22/97	11:00		0.66	10 U	6210	1.2	1560		0.05	723			700	850	5 U	170
DR-8-SW	1/22/97	9:40		1.98	12	63	0.5 U	180		0.08	1160			929	1110	5 U	250
DR-9-SW	1/22/97	12:20		0.66	10 U	372	0.5 U	1110		0.02 U	229			421	100	6	160
DR-16-SW	1/22/97	9:18		17.0	10 U	72	0.6	888		0.07	8740			1020	1200	5 U	360
DR-18-SW	1/23/97	9:25		0.67	10 U	145	0.5 U	257		0.02 U	164			212	293	5 U	110
SVS-8	1/21/97	14:15		1.78	10 U	148	0.5 U	615		0.02 U	840			184	237	5 U	81
SVS-11	1/21/97	13:45		2.12	10 U	53	0.5 U	3610		0.02 U	2190			695	972	5 U	560
SVS-12	1/21/97	10:45		0.58	10 U	10200	2.0	5250		0.02 U	4710			444	662	10	330
Bottle Blank	1/22/97	9:40													22	5 U	0.2 U
Filter Blank	1/22/97	9:40		0.02 U	10 U	20 U	0.5 U	5 U		0.02 U	10 U			0.2 U			

TABLE 1. (cont.)

Station	Date	Time	Field Rep.	Dissolved Metals (µg/L)								Tetra-chloro-ethene (µg/L)	Total Cyanide (mg/L)	Hardness (mg/L)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Sulfate (mg/L)
				Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc						
SPRING QUARTER 1997																	
DR-1-SW	4/17/97	9:00		10.7	61	12900	2.75	3380		0.02 U	4390			345	478	32 J	230
DR-2-SW	4/18/97	12:20		0.57	10 U	56	0.5 U	109		0.02 U	128			163	178	5 U	55
DR-4-SW	4/18/97	9:00		0.53	10 U	108	0.5 U	139		0.02 U	141			174	241	5 UU	62
DR-6-SW	4/17/97	13:20		0.77	10 U	55	0.55	181		0.02 U	191			201	238	5 UU	40
DR-7-SW	4/17/97	14:25		1.29	10 U	2590	6.62	890		0.02 U	501			644	735	5 UU	120
DR-8-SW	4/16/97	18:10		2.17	17	49	0.5 U	396		0.03	1200			930	1060	5 U	300
DR-8-SW	4/16/97	18:10	A	2.08	19	55	0.5 U	412		0.03	1210			958	1150	5 U	290
DR-9-SW	4/17/97	11:20		0.68	10 U	147	0.5 U	621		0.02 U	248			310	357	5 UU	95
DR-10-SW	4/17/97	11:40		1.52	10	52	0.5 U	194		0.02 U	775			903	1080	5 UU	320
DR-15A-SW	4/17/97	13:40		0.60	10 U	20 U	0.88	5 U		0.02 U	103			80.1	124	5 UU	18
DR-16-SW	4/16/97	17:30		13.6	10 U	62	0.5 U	1270		0.02 U	7620			1010	967	5 U	250
DR-18-SW	4/18/97	10:45		0.52	10 U	122	0.5 U	127		0.02 U	134			160	182	5 UU	56
SVS-5	4/16/97	11:30		2.32	10 U	27	0.5 U	82		0.02 U	358			108	141	5 U	16
SVS-8	4/16/97	15:00		2.16	10 U	40	0.5 U	403		0.02 U	633			174	236	5 U	72
SVS-11	4/16/97	14:00		1.94	10 U	2100	0.5 U	6260		0.02 U	4170			761	1050	11	570
SVS-12	4/16/97	12:50		0.76	10 U	12200	1.14	8010		0.02 U	6690			703	1010	6	550
Bottle Blank ^b	4/18/97	12:20													5 U	5 U	0.2 U
Filter Blank ^b	4/18/97	12:20		0.02 U	10 U	20 U	0.5 U	5 U		0.02 U	10 U			0.5			
Filter Blank ^c	4/18/97	12:20		0.02 U	10 U	20 U	0.5 U	5 U		0.02 U	10 U			0.2 U			
SUMMER QUARTER 1997																	
DR-1-SW	7/30/97	15:50		0.2	10 U	98	0.5 U	66		0.1 U	65			67.2	122	140	20
DR-2-SW	7/30/97	13:00		0.3	10 U	53	0.5 U	62		0.1 U	90			83.0	142	48	26
DR-4-SW	7/30/97	15:15		0.1 U	10 U	62	0.5 U	48		0.1 U	36			79.0	125	159	25
DR-6-SW	7/31/97	10:40		0.5	10 U	126	0.7	209		0.1 U	127			122	169	5 U	26
DR-7-SW	7/31/97	11:30		1.5	10 U	3120	4.2	963		0.1 U	567			599	686	5 U	140
DR-8-SW	7/30/97	10:30		3.5	21	36	0.5 U	357		0.1 U	1480			858	1080	5 U	280
DR-10-SW	7/31/97	9:15		1.7	10 U	101	0.5 U	366		0.1 U	626			760	983	5 U	290
DR-15a-SW	7/31/97	11:00		0.5	10 U	20 U	0.8	5 U		0.1 U	76			65.3	116	5 U	15
DR-16-SW	7/30/97	8:20		15.9	10 U	52	0.5 U	1930		0.1 U	7690			1030	840	8	200
DR-18-SW	7/30/97	14:30		0.1 U	10 U	68	0.5 U	52		0.1 U	41			74.0	121	168	23
SVS-5	7/29/97	10:30		2.1	10 U	341	0.7	143		0.1 U	353			87.2	112	5 U	14
SVS-8	7/29/97	12:22		1.8	10 U	101	0.6	235		0.1 U	347			112	178	5 U	36
SVS-8	7/29/97	12:22	A	1.8	10 U	84	0.5 U	231		0.1 U	340			110	162	5 U	35
SVS-11	7/29/97	13:55		1.9	10 U	2260	0.5 U	6690		0.1 U	3620			792	1170	5 U	690

TABLE 1. (cont.)

Station	Date	Time	Field Rep.	Dissolved Metals ($\mu\text{g/L}$)							Tetra-chloro-ethene ($\mu\text{g/L}$)	Total Cyanide (mg/L)	Hardness (mg/L)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Sulfate (mg/L)
				Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc					
SVS-12	7/29/97	15:10		0.5	10 U	11900	5.9	7250		0.1 U	5890					
SVS-12	7/29/97	15:10	A									0.01 U	710	1090	10	480
Bottle Blank	7/30/97	14:30										0.02				
Filter Blank	7/30/97	14:30		0.1 U	10 U	20 U	0.5 U	5 U		0.1 U	10 U		0.3	18	5 U	0.2 U

The MRL is elevated because of matrix interferences.

Peristaltic pump and cartridge filters.

Hand pump and vacuum filters.

Qualifier: U - Undetected at detection limit shown.

J - Sample result is an estimate due to exceedance of quality control criteria.

Winter Quarterly Sampling Event

The sample set consisted of 11 surface water samples, one field duplicate sample, one bottle blank, and one filter blank. All analyses were conducted by Columbia Analytical Services, Inc. (Kelso, Washington). The samples were analyzed for dissolved metals (cadmium, copper, iron, lead, manganese, silver, and zinc), TDS, TSS, sulfate, and hardness (as calcium carbonate).

Spring Quarterly Sampling Event

The sample set consisted of 15 surface water samples, one field duplicate sample, one bottle blank, and two filter blanks. All analyses were conducted by Columbia Analytical Services, Inc. (Kelso, Washington). The samples were analyzed for dissolved metals (cadmium, copper, iron, lead, manganese, silver, and zinc), TDS, TSS, sulfate, and hardness (as calcium carbonate).

Summer Quarterly Sampling Event

The sample set consisted of 14 surface water samples, one field duplicate sample, one bottle blank, and one filter blank. All analyses were conducted by Columbia Analytical Services, Inc. (Kelso, Washington). The samples were analyzed for dissolved metals (cadmium, copper, iron, lead, manganese, silver, and zinc), TDS, TSS, sulfate, and hardness (as calcium carbonate). In addition, one surface water sample and one field duplicate sample were analyzed for total cyanide.

SUMMARY OF QUALIFIED DATA

A summary of quality control checks is included in Table 2.

Fall Quarterly Sampling Event

Dissolved Metals

A total of 106 analytical results were reported by the laboratory. Of these results, 69 were reported at concentrations above the applicable MRL and 37 were reported as undetected (the applicable MRL was reported by the laboratory with a *U* qualifier).

During the quality assurance review, six lead results were restated as undetected (the results reported by the laboratory were assigned a *U* qualifier because lead was present in the affected samples at concentrations less the action limit of 5 times the concentration detected

TABLE 2. SUMMARY OF QUALITY CONTROL CHECKS

Quality Control Check	Status	Comment
Completeness	100 percent complete	690 results reported; no results were rejected
Holding times	Acceptable	Holding time constraints were met
Analytical methods	Acceptable	See <i>Analytical Methods</i> section
Instrument performance	Acceptable	
Calibrations	Acceptable	Control limits were met
Method blanks	Acceptable	Control limits were met
Accuracy (bias or recovery)		
Laboratory control samples	Acceptable	Control limits were met
Matrix spike samples	Acceptable	Control limits were met
Surrogate compounds	Acceptable	Control limits were met
Accuracy (precision)	Acceptable	Control limits were met, with one exception. Total of 8 TSS results associated with spring quarterly sampling event qualified as estimated (J); see <i>Precision</i> section
Method reporting limits	Acceptable	Method reporting limits met data quality objectives; reporting limits for some samples were elevated because of matrix interferences
Field quality control samples	Acceptable	Total of 6 dissolved lead results associated with the fall quarterly sampling event were restated as undetected (U); results discussed in <i>Field Quality Control Samples</i> section of report
OVERALL ASSESSMENT	ACCEPTABLE	Qualifiers were added to selected results; see sections noted above

in the filter blank. No results were qualified as estimated or rejected during the quality assurance review.

TDS, TSS, Sulfate, and Hardness

A total of 15 analytical results for TDS, TSS, sulfate, and hardness were reported by the laboratory. Of these results, 14 TDS, 5 TSS, 14 sulfate, and 14 hardness results were reported at concentrations above the applicable MRL. Ten TSS, one TDS, one sulfate, and one hardness results were reported as undetected (the applicable MRL was reported by the laboratory with a *U* qualifier). No results were qualified as estimated, restated as undetected, or rejected during the quality assurance review.

Total Cyanide

A total of three results were reported by the laboratory as undetected (the MRL was reported by the laboratory with a *U* qualifier). No results were qualified as estimated, restated as undetected, or rejected during the quality assurance review.

PCE

A total of five results were reported by the laboratory as undetected (the MRL was reported by the laboratory with a *U* qualifier). No results were qualified as estimated, restated as undetected, or rejected during the quality assurance review.

Winter Quarterly Sampling Event

Dissolved Metals

A total of 91 analytical results were reported by the laboratory. Of these results, 57 were reported at concentrations above the applicable MRL and 34 were reported as undetected (the applicable MRL was reported by the laboratory with a *U* qualifier). No results were qualified as estimated, restated as undetected, or rejected during the quality assurance review.

TDS, TSS, Sulfate, and Hardness

A total of 13 analytical results for TDS, TSS, sulfate and hardness were reported by the laboratory. Of these results, all 13 TDS, 3 TSS, 12 sulfate, and 12 hardness results were reported at concentrations above the applicable MRL. Ten TSS, 1 sulfate, and 1 hardness results were reported as undetected (the applicable MRL was reported by the laboratory

with a *U* qualifier). No results were qualified as estimated, restated as undetected, or rejected during the quality assurance review.

Spring Quarterly Sampling Event

Dissolved Metals

A total of 126 analytical results were reported by the laboratory. Of these results, 73 were reported at concentrations above the applicable MRL and 53 were reported as undetected (the applicable MRL was reported by the laboratory with a *U* qualifier). No results were qualified as estimated, restated as undetected, or rejected during the quality assurance review.

TDS, TSS, Sulfate, and Hardness

A total of 17 analytical results for TDS, TSS, and sulfate and 18 analytical results for hardness were reported by the laboratory. Of these results, all 16 TDS, 3 TSS, 16 sulfate, and 17 hardness results were reported at concentrations above the applicable MRL. One TDS, 14 TSS, 1 sulfate, and 1 hardness results were reported as undetected (the applicable MRL was reported by the laboratory with a *U* qualifier).

During the quality assurance review, eight TSS results were qualified as estimated (assigned a *J* qualifier) because the result for the relative percent difference for laboratory duplicate sample analyses (22 percent) was outside the control limit of 20 percent. No results were restated as undetected or rejected during the quality assurance review.

Summer Quarterly Sampling Event

Dissolved Metals

A total of 112 analytical results were reported by the laboratory. Of these results, 63 were reported at concentrations above the applicable MRL and 49 were reported as undetected (the applicable MRL was reported by the laboratory with a *U* qualifier). No results were qualified as estimated, restated as undetected, or rejected during the quality assurance review.

TDS, TSS, Sulfate, and Hardness

A total of 16 analytical results for TDS, TSS, sulfate and hardness were reported by the laboratory. Of these results, all 16 TDS, 6 TSS, 15 sulfate, and all 16 hardness results were reported at concentrations above the applicable MRL. Ten TSS and one sulfate results

were reported as undetected (the applicable MRL was reported by the laboratory with a *U* qualifier). No results were qualified as estimated, restated as undetected, or rejected during the quality assurance review.

Total Cyanide

A total of two results were reported by the laboratory. Of these results, one was reported at a concentration above the applicable MRL and one was reported as undetected (the MRL was reported by the laboratory with a *U* qualifier). No results were qualified as estimated, restated as undetected, or rejected during the quality assurance review.

SAMPLE DELIVERY GROUPS

The water samples for the four sampling events were analyzed for the target analytes in four sample delivery groups (SDGs). The data packages for these SDGs contained all documentation and data necessary to conduct the quality assurance review.

DATA QUALITY ASSESSMENT

The results for quality control procedures employed for the analysis of field samples are discussed below, including completeness, holding times, analytical methods, instrument performance, accuracy, quantification, method reporting limits, and field quality control samples. Data quality was assessed in terms of method-specific and laboratory-specific control limits and requirements specified by the applicable EPA national functional guidelines (U.S. EPA 1994a,b).

Completeness

The results reported by the laboratory were 100-percent complete. No data were rejected during the quality assurance review.

Holding Times

All analytical holding time constraints and sample preservation requirements were met for all samples.

Analytical Methods

Analyses for copper, iron, manganese, and zinc were completed according to EPA SW-846 Method 6010A using inductively coupled plasma-atomic emission spectrometry (ICP-AES) (U.S. EPA 1992). Analyses for cadmium, lead, and silver were completed according to EPA Method 200.8 using inductively coupled plasma-mass spectrometry (ICP/MS) (U.S. EPA 1991). Analyses for mercury were completed according to EPA SW-846 Method 7470A (U.S. EPA 1994c) using cold vapor atomic absorption.

For conventional analytes, analyses were completed according to the following methods: TDS by EPA Method 160.1 (U.S. EPA 1983); TSS by EPA Method 160.2 (U.S. EPA 1983); sulfate by EPA Method 300.0 (U.S. EPA 1983); and hardness using analytical results obtained for the analysis of calcium and magnesium using EPA SW-846 Method 6010A (U.S. EPA 1992) and the equation defined in Standard Method 2340B (APHA 1989). The analyses for cyanide were completed using EPA Method 335.2 (U.S. EPA 1983). The analyses for PCE were completed by EPA SW-846 Method 5030A (U.S. EPA 1992) and 8010B (U.S. EPA 1994c) using purge-and-trap and gas chromatography/electrolytic conductivity detection, respectively.

Instrument Performance

The results for the applicable calibrations and calibration blanks associated with the sample analyses are described below. No changes in instrument performance were indicated during any analysis sequence that would have resulted in the degradation of data quality.

Initial Calibration

The initial calibrations completed for all metals, sulfate, cyanide, and PCE analyses met the criteria for acceptable performance and frequency of analysis. Initial calibrations are not performed for the other conventional analytes.

Initial and Continuing Calibration Verification

The initial and continuing calibration verifications for all metals, sulfate, cyanide, and PCE analyses met the criteria for acceptable performance and frequency of analysis. Initial and continuing calibration verifications are not performed for the other conventional analytes.

Initial and Continuing Calibration Blanks

The initial and continuing calibration blanks met the criteria for acceptable performance and frequency of analysis. For the non-metals analyses, no analytes were detected in applicable

initial and continuing calibration blanks. For the analysis of metals, no target analytes were detected at concentrations greater than 2 times the instrument detection limit.

Method Blank Analyses

The analyses of the method blanks met the criteria for acceptable performance and frequency of analysis. For the non-metals analyses, no analytes were detected in applicable method blanks. For the analysis of metals, no target analytes were detected at concentrations greater than 2 times the instrument detection limit.

Accuracy

The accuracy of the analytical results is evaluated in the following sections in terms of analytical bias (laboratory control sample, matrix spike, and surrogate recoveries) and precision (laboratory duplicates).

Laboratory Control Sample Recoveries

The recoveries for all laboratory control samples (blank spikes) and the frequency of analysis met the criteria for acceptable performance. A summary of all laboratory control sample recoveries for metals, conventional analytes, cyanide, and PCE is presented in Appendix D.

Matrix Spike Recoveries

The recoveries for all matrix spike samples and the frequency of analysis met the criteria for acceptable performance. A summary of matrix spike recoveries for metals, sulfate, cyanide, and PCE is presented in Appendix D. Matrix spikes are not performed for other conventional analytes.

Surrogate Compound Recoveries

The recoveries for the surrogate compounds added to samples analyzed for PCE met the criteria for acceptable performance. A summary of the surrogate compound recoveries is presented in Appendix D.

Precision

The results for all duplicate sample analyses (metals, conventional analytes, and cyanide) and duplicate matrix spike analyses for PCE, including the frequency of analysis, met the criteria for acceptable performance, with one exception: For the analysis of TSS conducted for eight samples collected during the spring quarter, the RPD between the original sample analysis and the laboratory duplicate sample analysis exceeded the control limit of 20 percent. Specifically, an RPD of 22 was reported for the sample collected at Station No. DR-1-SW (32 mg/L) and the laboratory duplicate sample result (40 mg/L). The TSS results reported for the eight samples associated with the affected laboratory duplicate were qualified as estimated (assigned a *J* qualifier) during the quality assurance review.

A summary of all duplicate analyses for metals, conventional analytes, cyanide, and PCE is presented in **Appendix D**.

Method Reporting Limits

The method reporting limits (MRLs) were acceptable for all target analytes. A slightly elevated MRL of 0.03 µg/L, rather than the routine MRL of 0.02 µg/L, was reported for silver in the three samples (Stations DR-2-SW, the field duplicate of DR-2-SW, and DR-4-SW) collected during the winter quarterly sampling event. This slightly elevated MRL is due to matrix interferences documented by the laboratory.

FIELD QUALITY CONTROL

For samples collected for the fall quarterly sampling event, the field quality control samples included a total of five field duplicates, one bottle blank, and one filter blank. Two field duplicate samples were collected at Station No. SVS-12 and were analyzed for dissolved metals, total cyanide, hardness, TDS, TSS, and sulfate. A total of five field duplicate samples were collected at Station No. SVS-12 and were analyzed for PCE. The bottle blank was analyzed for TDS, TSS, and sulfate and the filter blank was analyzed for dissolved metals and hardness.

For samples collected for the winter quarterly sampling event, the field quality control samples included one field duplicate sample, one bottle blank, and one filter blank. The field duplicate samples were collected at Station No. DR-2-SW and were analyzed for dissolved metals, hardness, TDS, TSS, and sulfate. The bottle blank was analyzed for TDS, TSS, and sulfate and the filter blank was analyzed for dissolved metals and hardness.

For samples collected for the spring quarterly sampling event, the field quality control samples included one field duplicate sample, one bottle blank, and two filter blanks. The field duplicate samples were collected at Station No. DR-8-SW and were analyzed for dissolved metals, hardness, TDS, TSS, and sulfate. The bottle blank was analyzed for

TDS, TSS, and sulfate and the filter blanks were analyzed for dissolved metals and hardness.

For samples collected for the summer quarterly sampling event, the field quality control samples included a total of two field duplicate samples, one bottle blank, and one filter blank. One set of field duplicate samples was collected at Station No. SVS-8 and analyzed for dissolved metals, hardness, TDS, TSS, and sulfate. The other set of field duplicate samples was collected at Station No. SVS-12 and analyzed for total cyanide. The bottle blank was analyzed for TDS, TSS, and sulfate and the filter blank was analyzed for dissolved metals and hardness.

Field Duplicates

For the field duplicates, data quality was assessed by evaluating the RPD of analytes detected in associated field duplicate samples. The RPDs for analytes detected in all of the associated field duplicate samples were acceptable.

Field Blanks

No target analytes were detected in any field blank, with six exceptions:

For the filter blank associated with the fall quarterly sampling event, dissolved cadmium and lead were detected at 0.03 $\mu\text{g/L}$ and 0.06 $\mu\text{g/L}$, respectively. No cadmium results required qualification because the concentrations present in the associated samples were greater than the action limit of 5 times the concentration detected in the filter blank. During the quality assurance review, six dissolved lead results were restated as undetected (the results reported by the laboratory were assigned a *U* qualifier) because lead was present in the affected samples at concentrations less than the action limit of 5 times the concentration detected in the filter blank.

For the bottle blank associated with the winter quarterly sampling event, TDS was detected at 22 mg/L. No TDS results required qualification because the concentrations present in the associated samples were greater than the action limit of 5 times the concentration in the bottle blank.

For the filter blank collected using the peristaltic pump and cartridge filter associated with the spring quarterly sampling event, hardness (as calcium carbonate) was detected at 0.5 mg/L. No hardness results required qualification because the concentrations present in the associated samples were greater than the action limit of 5 times the concentration in the filter blank.

For the bottle blank and filter blank associated with the summer quarterly sampling event, TDS and hardness (as calcium carbonate) were detected at 18 mg/L and 0.3 mg/L, respectively. No TDS or hardness results required qualification because these two analytes were present in the associated samples at concentrations greater than the action limit of 5 times the concentration present in the respective field blank.

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APHA. 1989. Standard methods for the analysis of water and wastewater. 17th ed. American Public Health Association, American Water Works Association, Water Pollution Control Federation, Washington, DC.

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U.S. EPA. 1994a. USEPA contract laboratory program national functional guidelines for inorganic data review. EPA 540/R-94/013. February 1994. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 1994b. USEPA contract laboratory program national functional guidelines for organic data review. EPA 540/R-94/012. February 1994. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, DC.

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U.S. EPA. 1994c. Test methods for evaluating solid waste — physical/chemical methods (SW-846). Final Update II, Revision 1, September 1994. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, DC.

**E2 Quarterly Data Validation
Summary Reports**



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December 17, 1996

Mr. Edmund J. Schneider, P.G.
ESA Consultants, Inc.
2637 Midpoint Drive, Suite F
Fort Collins, Colorado 80525

Subject: Data Validation Summary for Rico Surface Water Sampling (Fall 1996 Quarter)
PTI Contract CB41-01-01

Dear Mr. Schneider:

PTI has completed a Level 3 quality assurance review of the chemical analyses conducted on surface water samples collected for the fall 1996 quarterly sampling event at the Rico Mine. Data quality was assessed in terms of method-specific quality control limits and guidance specified by U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic and Organic Data Review. The analytical results and data qualifiers associated with the sample set are presented in Table 1 (attached). An electronic copy of the validated analytical results is also provided. The sample set, overall data quality, and results for the field quality control samples are summarized below.

Sample Set

The sample set consisted of 13 surface water samples, five field duplicate samples, one filter blank, and one bottle blank. All analyses were conducted by Columbia Analytical Services, Inc. (Kelso, Washington). The analyses conducted on the samples included:

- Thirteen surface water samples and one field duplicate sample were analyzed for dissolved cadmium, copper, iron, lead, manganese, silver, and zinc; total dissolved solids (TDS); total suspended solids (TSS); sulfate; and hardness (as CaCO_3).
- One surface water sample was analyzed for dissolved mercury.
- Two surface water samples and one field duplicate sample were analyzed for total cyanide.
- Three surface water samples and two field duplicates were analyzed for tetrachloroethene (PCE).
- One filter blank was analyzed for dissolved metals and hardness.
- One bottle blank was analyzed for TDS, TSS, and sulfate.

Overall Data Quality

The results for all quality control procedures employed by the laboratory during analysis of the samples are acceptable. Results for all field quality control samples were acceptable; however, six lead results were restated as undetected because this analyte was also detected in the associated field blank. No results were rejected during the quality assurance review.

Dissolved Metals — The laboratory reported a total of 106 analytical results. Of these results, 75 were reported at concentrations above the applicable method reporting limit (MRL) and 31 were reported as undetected (the applicable MRL was reported by the laboratory with a *U* qualifier). During the quality assurance review, six dissolved lead results were restated as undetected (assigned a *U* qualifier) at the concentrations reported by the laboratory.

TDS, TSS, Sulfate, and Hardness — The laboratory reported a total of 15 analytical results for TDS, TSS, sulfate, and hardness. Of these results, 14 TDS, 5 TSS, 14 sulfate, and 14 hardness results were reported at concentrations above the applicable MRL. One TDS, 10 TSS, 1 sulfate, and 1 hardness results were reported as undetected (the applicable MRL was reported by the laboratory with a *U* qualifier).

Total Cyanide — All three cyanide results were reported as undetected by the laboratory and the MRL was reported with a *U* qualifier.

PCE — All five PCE were reported as undetected by the laboratory and the MRL was reported with a *U* qualifier.

Field Quality Control Samples

The field quality control samples included five field duplicate samples, one filter blank, and one bottle blank. All field duplicate samples were collected from station SVS-12 and included the following samples:

- Sample 00135 is a duplicate of Sample 00129 and was analyzed for dissolved metals and hardness
- Sample 00136 is a duplicate of Sample 00130 and was analyzed for TDS, TSS, and sulfate
- Sample 00137 is a duplicate of Sample 00131 and was analyzed for cyanide
- Samples 00138 and 00139 are duplicates of Samples 00132 and 00133 and were analyzed for PCE.

The relative percent differences between the original sample analysis and the duplicate field sample analysis for all analytes of concern were acceptable.

Mr. Edmund J. Schneider, P.G.

December 17, 1996

Page 3

The filter blank (Sample 00147) was analyzed for dissolved metals and hardness. The bottle blank (Sample 00148) was analyzed for TDS, TSS, and sulfate. No target analytes were detected in the filter or bottle blanks with the exception of dissolved cadmium ($0.03 \mu\text{g/L}$) and dissolved lead ($0.06 \mu\text{g/L}$). No cadmium results required qualification because this metal was detected in the field samples at concentrations above the action limit. However, six dissolved lead results (Samples 00127, 00145, 00151, 00156, 00158, and 00160) were restated as undetected (a *U* qualifier was assigned to the concentration of lead detected in the affected samples). These results were restated as undetected because lead was present in the affected samples at concentrations less than the action limit (i.e., lead was detected at concentrations of less than 5 times the concentration of lead detected in the associated blank).

If you have any questions or comments regarding the information presented in this letter or the data table, please feel free to contact Ms. Laura Jones at (503) 636-4338 or me at (206) 643-9803. PTI appreciates the opportunity to support ESA on this project.

Sincerely,



James J. McAteer, Jr.
Quality Assurance Chemist

Attachment

cc: Mr. Todd Sullivan/ESA
Ms. Laura Jones/PTI Lake Oswego

RICO POST VOLUNTARY CLEANUP PROGRAM SURFACE WATER SAMPLE RESULTS - FALL QUARTER

Station	Date	Time	Field Rep.	Dissolved Metals (µg/L)								Tetra-chloro-ethene (µg/L)	Total Cyanide (mg/L)	Hardness (mg/L)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Sulfate (mg/L)
				Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc						
DR-1-SW	10/23/96	15:50		5.32	15	6090	1.09	1660		0.02 U	1950		0.01 U	214	296	15	130
DR-2-SW	10/24/96	11:15		0.59	10 U	57	0.12 U	172		0.02 U	123			169	228	5 U	80
DR-4-SW	10/24/96	9:00		0.53	10 U	112	0.12 U	175		0.02 U	124			171	233	5	78
DR-6-SW	10/23/96	10:40		0.87	10 U	51	0.35	183		0.02 U	224			189	233	5 U	55
DR-7-SW	10/23/96	9:15		0.72	10 U	8370	5.60	1700		0.02 U	883			738	910	5 U	200
DR-8-SW	10/23/96	14:45		1.96	14	59	0.18 U	203	0.2 U	0.02 U	1300			1020	1210	5 U	280
DR-9-SW	10/23/96	11:50		0.61	10 U	247	0.11 U	854		0.02 U	168			433	576	5 U	200
Filter Blank	10/23/96	14:00		0.03	10 U	20 U	0.06	5 U		0.02 U	10 U			0.2 U			
Bottle Blank	10/23/96	14:00													5 U	5 U	0.2 U
DR-16-SW	10/23/96	14:00		15.0	10 U	63	2.38	811		0.02 U	9080			1020	1350	5 U	390
DR-18-SW	10/24/96	10:15		0.52	10 U	107	0.12 U	180		0.02 U	123			172	234	5 U	90
SVS-5	10/22/96	12:01		3.44	14	156	2.65	138		0.02 U	677			114	159	5 U	24
SVS-8	10/22/96	14:15		2.28	10 U	141	0.88	392		0.02 U	738			151	190	6	64
SVS-11	10/22/96	15:05		2.12	10 U	5080	0.04 U	6880		0.02 U	5410			618	832	26	510
SVS-12	10/22/96	16:25	1	3.45	10 U	5880	1.02	4990		0.02 U	5530	0.5 U	0.01 U	533	760	5 U	390
SVS-12	10/22/96	16:25	2	3.48	10 U	6010	0.92	5100		0.02 U	5640	0.5 U	0.01 U	545	751	6	410
SVS-12	10/22/96	16:25	3									0.5 U					
SVS-12	10/22/96	16:25	4									0.5 U					
SVS-12	10/22/96	16:25	5									0.5 U					



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March 18, 1997

Mr. Edmund J. Schneider, P.G.
ESA Consultants, Inc.
2637 Midpoint Drive, Suite F
Fort Collins, Colorado 80525

Subject: Data Validation Summary for Rico Sampling — Winter Quarter 1997
PTI Contract CB41-01-01

Dear Mr. Schneider:

PTI has completed an abbreviated Level 3 quality assurance review of the chemical analyses conducted on surface water samples collected for 1997 winter quarter sampling event at the Rico Mine. The results reported by the laboratory are acceptable and no results were qualified during the quality assurance review.

Data quality was assessed in terms of applicable method-specific quality control limits and guidance specified by U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. The analytical results and associated data qualifiers associated with the sample set are presented in Table 1 (attached). An electronic copy of the validated analytical results is also provided. The sample set, overall data quality, and results for the field quality control samples are summarized below.

Sample Set

The sample set consisted of 11 surface water samples, 1 field duplicate sample, 1 filter blank, and 1 bottle blank. All analyses were conducted by Columbia Analytical Services, Inc. (Kelso, Washington). Eleven surface water samples, one field duplicate sample, and one filter blank were analyzed for dissolved metals (cadmium, copper, iron, lead, manganese, silver, and zinc) and hardness (as CaCO_3). Eleven surface water samples, one field duplicate sample, and one bottle blank were analyzed for total suspended solids (TSS), total dissolved solids (TDS), and sulfate.

Overall Data Quality

The results for all quality control procedures employed by the laboratory during analysis of the samples and results for all field quality control samples are acceptable. No results were

qualified or rejected during the quality assurance review. Data quality was assessed by reviewing the laboratory case narrative and the results of analytical quality control measurements for each sample delivery group. To determine whether detected analytes were the result of possible contamination at the laboratory, the results for all method blanks analyzed with the samples were reviewed. No target analytes were detected in any method blank. Analytical accuracy was quantified as the recovery of matrix spike analyses for dissolved metals and sulfate. Analytical precision was quantified as the relative percent difference (RPD) between duplicate sample analyses for all analytes. The control limits for matrix spike recoveries and duplicate sample analyses were met.

Matrix spike recoveries were not calculated for iron, manganese, and zinc because the concentrations of these metals in the natural sample were significantly greater than the concentrations used to spike the sample. No data require qualification for the absence of these matrix spike recoveries. An elevated method reporting limit was reported for silver due to matrix interferences documented by the laboratory in three samples: station DR-2-SW, the field duplicate collected from DR-2-SW, and DR-4-SW.

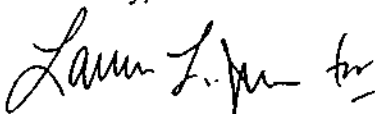
Field Quality Control Samples

The field quality control samples included one field duplicate sample collected from station DR-2-SW, one filter blank, and one bottle blank. The relative percent differences between the original sample analyses and the duplicate field sample analyses for all analytes of concern were acceptable. No target analytes were detected in the filter blank and bottle blank, with the exception of TDS. No sample results required qualification based on the detection of TDS in the bottle blank. For future sampling events, we recommend analyzing the bottle blank for metals instead of for TDS, TSS, and sulfate, to rule out potential contamination of the metals samples.

ENO. All metals samples are filtered in the field - Filter Blank is proper QC. TDS, TSS & Sulfate are not filtered - Bottle Blank is proper QC. T.S. 3-31-97

If you have any questions or comments regarding the information presented in this letter or the data table, please feel free to contact Ms. Laura Jones at (503) 636-4338 or me at (206) 643-9803. PTI appreciates the opportunity to support ESA Consultants, Inc. on this project.

Sincerely,



James J. Mc Ateer, Jr.
Quality Assurance Chemist

Attachment

cc: Mr. Todd Sullivan, ESA Consultants, Inc.
Ms. Laura Jones, PTI Lake Oswego

RICO POST VOLUNTARY CLEANUP PROGRAM SURFACE WATER SAMPLE RESULTS - WINTER QUARTER

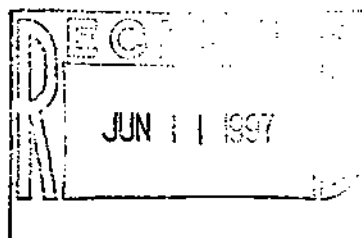
Station	Date	Time	Field Rep.	Dissolved Metals (µg/L)							Hardness (mg/L)	Total Dissolved	Total Suspended	Sulfate (mg/L)
				Cadmium	Copper	Iron	Lead	Manganese	Silver	Zinc		Solids (mg/L)	Solids (mg/L)	
DR-1-SW	1/22/9	####		5.03	13	8090	0.6	1350	0.02 U	1810	258	353	16	150
DR-16-SW	1/22/9	9:18		17.0	10 U	72	0.6	888	0.07	8740	1020	1200	5 U	360
DR-18-SW	1/23/9	9:25		0.67	10 U	145	0.5 U	257	0.02 U	184	212	293	5 U	110
DR-2-SW	1/23/9	####		0.76	10 U	80	0.5 U	259	0.03 ^a U	173	217	301	5 U	100
DR-2-SW	1/23/9	####	A	0.74	10 U	75	0.5 U	258	0.03 ^a U	170	216	283	5 U	100
DR-4-SW	1/23/9	9:00		0.70	10 U	141	0.5 U	269	0.03 ^a U	178	226	299	5 U	110
DR-7-SW	1/22/9	####		0.66	10 U	6210	1.2	1560	0.05	723	700	850	5 U	170
DR-8-SW	1/22/9	9:40		1.98	12	63	0.5 U	180	0.08	1160	929	1110	5 U	250
Filter Blank	1/22/9	9:40		0.02 U	10 U	20 U	0.5 U	5 U	0.02 U	10 U	0.2 U			
Bottle Blank	1/22/9	9:40										22	5 U	0.2 U
DR-9-SW	1/22/9	####		0.66	10 U	372	0.5 U	1110	0.02 U	229	421	524	6	160
SVS-11	1/21/9	####		2.12	10 U	53	0.5 U	3610	0.02 U	2190	695	972	5 U	560
SVS-12	1/21/9	####		0.58	10 U	10200	2.0	5250	0.02 U	4710	444	662	10	330
SVS-8	1/21/9	####		1.78	10 U	148	0.5 U	615	0.02 U	840	184	237	5 U	81

^aThe MRL is elevated because of matrix interferences.



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June 10, 1997

Mr. Edmund J. Schneider, P.G.
ESA Consultants, Inc.
2637 Midpoint Drive, Suite F
Fort Collins, Colorado 80525

Subject: Data Validation Summary for Rico Sampling - Spring Quarter 1997
PTI Contract CB41-01-01

Dear Mr. Schneider:

PTI has completed an abbreviated Level 3 quality assurance review of the chemical analyses conducted on surface water samples collected for 1997 spring quarter sampling event at the Rico Mine. Selected results reported by the laboratory were qualified as estimated during the quality assurance review.

Data quality was assessed in terms of applicable method-specific quality control limits and guidance specified by U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. The analytical results and associated data qualifiers associated with the sample set are presented in Table 1 (attached). An electronic copy of the validated analytical results is also provided. The sample set, overall data quality, and results for the field quality control samples are summarized below. PTI contacted Columbia Analytical Services during the quality assurance review and requested resubmittal of the lead data because the original package did not include the project-specific reporting limit of 0.5 µg/L for lead. PTI received the resubmitted data on June 9, 1997, and updated Table 1 to reflect the changes.

Sample Set

The sample set consisted of 15 surface water samples, 1 field duplicate, 2 filter blanks (1 filter blank for the peristaltic pump and cartridge filters and 1 filter blank for the hand pump and vacuum filters), and 1 bottle blank. Fifteen surface water samples, one field duplicate sample, and two filter blanks were analyzed for dissolved metals (cadmium, copper, iron, lead, manganese, silver, and zinc) and hardness (as CaCO₃). Fifteen surface water samples, one field duplicate sample, and one bottle blank were analyzed for total dissolved solids (TDS), total suspended solids (TSS), and sulfate. All analyses were conducted by Columbia Analytical Services, Inc. (Kelso, Washington).

Overall Data Quality

The results for all quality control procedures employed by the laboratory during analysis of the samples and field quality control samples are acceptable. No results were rejected; however, selected results were qualified during the quality assurance review. Data quality was assessed by reviewing the laboratory case narrative and the results of analytical quality control measurements for each sample delivery group. To determine whether detected analytes were the result of possible contamination at the laboratory, the results for all method blanks analyzed with the samples were reviewed. No target analytes were detected in any method blank. Analytical accuracy was quantified as the recovery of matrix spike analyses for dissolved metals and sulfate. Analytical precision was quantified as the relative percent difference (RPD) between duplicate sample analyses for all analytes. The control limits for matrix spike recoveries were met. Eight total suspended solids results were qualified as estimated due to the relative percent difference (RPD) of the sample and corresponding laboratory duplicate result.

Field Quality Control Samples

The field quality control samples included one field duplicate sample collected from station DR-8-SW, two filter blanks (one filter blank from the peristaltic pump and cartridge filters and one from the hand pump and vacuum filters), and one bottle blank. The RPDs between the original sample analyses and the duplicate field sample analyses for all analytes of concern were acceptable. Hardness (as CaCO_3) was detected in the peristaltic pump filter blank. No sample results required qualification based on the detection of hardness in the filter blanks. The sample results for these analytes of concern were significantly higher than concentrations detected in the filter blanks.

If you have any questions or comments regarding the information presented in this letter or the data table, please feel free to contact Ms. Laura Jones or me at (503) 636-4338. PTI appreciates the opportunity to support ESA Consultants, Inc. on this project.

Sincerely,



Adam S. Bonin
Environmental Scientist

Attachment

cc: Mr. Todd Sullivan, ESA Consultants, Inc.
Ms. Laura Jones, PTI/Lake Oswego

RICO POST VOLUNTARY CLEANUP PROGRAM SURFACE WATER SAMPLE RESULTS - SPRING QUARTER

Station	Date	Time	Field Rep.	Dissolved Metals (µg/L)							Hardness (mg/L)	Total Dissolved Solids	Total Suspended Solids	Sulfate (mg/L)
				Cadmium	Copper	Iron	Lead	Manganese	Silver	Zinc		(mg/L)	(mg/L)	
SVS-5	4/16/97	11:30	A	2.32	10 U	27	0.5 U	82	0.02 U	358	108	141	5 U	16
SVS-12	4/16/97	12:50		0.76	10 U	12200	1.14	8010	0.02 U	6690	703	1010	6	550
SVS-11	4/16/97	14:00		1.94	10 U	2100	0.5 U	6260	0.02 U	4170	761	1050	11	570
SVS-8	4/16/97	15:00		2.16	10 U	40	0.5 U	403	0.02 U	633	174	236	5 U	72
DR-16-SW	4/16/97	17:30		13.6	10 U	62	0.5 U	1270	0.02 U	7620	1010	967	5 U	250
DR-8-SW	4/16/97	18:10		2.17	17	49	0.5 U	396	0.03	1200	930	1060	5 U	300
DR-8-SW	4/16/97	18:10		2.08	19	55	0.5 U	412	0.03	1210	958	1150	5 U	290
DR-1-SW	4/17/97	9:00		10.7	61	12900	2.75	3380	0.02 U	4390	345	478	32 J	230
DR-9-SW	4/17/97	11:20		0.68	10 U	147	0.5 U	621	0.02 U	248	310	357	5 U	95
DR-10-SW	4/17/97	11:40		1.52	10	52	0.5 U	194	0.02 U	775	903	1080	5 U	320
DR-6-SW	4/17/97	13:20	0.77	10 U	55	0.55	181	0.02 U	191	201	238	5 U	40	
DR-15A-SW	4/17/97	13:40	0.60	10 U	20 U	0.88	5 U	0.02 U	103	80.1	124	5 U	18	
DR-7-SW	4/17/97	14:25	1.29	10 U	2590	6.62	890	0.02 U	501	644	735	5 U	120	
DR-4-SW	4/18/97	9:00	0.53	10 U	108	0.5 U	139	0.02 U	141	174	241	5 U	62	
DR-18-SW	4/18/97	10:45	0.52	10 U	122	0.5 U	127	0.02 U	134	160	182	5 U	56	
DR-2-SW	4/18/97	12:20	0.57	10 U	56	0.5 U	109	0.02 U	128	163	178	5 U	55	
Filter Blank ^a	4/18/97	12:20	0.02 U	10 U	20 U	0.5 U	5 U	0.02 U	10 U	0.5				
Filter Blank ^b	4/18/97	12:20	0.02 U	10 U	20 U	0.5 U	5 U	0.02 U	10 U	0.2 U				
Bottle Blank	4/18/97	12:20										5 U	5 U	0.2 U

^aPeristaltic pump and cartridge filters.

^bHand pump and vacuum filters.

Qualifier: J - Sample result is an estimate due to exceedance of quality control criteria.

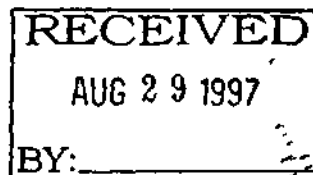
PTI

ENVIRONMENTAL SERVICES

4000 Kruse Way Place
Building #2, Suite 285
Lake Oswego, Oregon 97035
(503) 636-4338 FAX (503) 636-4315

FED
8/22/97

August 22, 1997



Mr. Edmund Schneider, P.G.
ESA Consultants
2637 Midpoint Drive, Suite F
Fort Collins, CO. 80525

Subject: Data Validation Summary for Rico Sampling - Summer Quarter 1997
PTI Contract CB41-01-01

Dear Mr. Schneider:

PTI has completed an abbreviated Level 3 quality assurance review of the chemical analyses conducted on surface water samples collected for the 1997 summer quarter sampling event at the Rico Mine. No results reported by the laboratory were qualified or rejected during the quality assurance review.

Data quality was assessed in terms of applicable method-specific quality control limits and guidance specified by *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. The analytical results and associated data qualifiers for all samples associated with the sample set are presented in Table 1 (attached). An electronic copy of the validated analytical results is also provided. The sample set, overall data quality, and results for the field quality control samples are summarized below.

Sample Set

The sample set consisted of 14 surface water samples, 2 field duplicate samples, 1 filter blank (collected using a peristaltic pump and cartridge filter), and 1 bottle blank. Fourteen surface water samples, one field duplicate sample, and the filter blank were analyzed for dissolved metals (cadmium, copper, iron, lead, manganese, silver, and zinc) and hardness (as CaCO_3). Fourteen surface water samples, one field duplicate, and the bottle blank were analyzed for total dissolved solids (TDS), total suspended solids (TSS), and sulfate. Also, one surface water sample and one field duplicate sample were analyzed for total cyanide. All analyses were conducted by Columbia Analytical Services, Inc. (Kelso, Washington).

Mr. Edmund J. Schneider, P.G.

August 22, 1997

Page 2

Overall Data Quality

The results for all applicable quality control procedures employed by the laboratory during analysis of the samples are acceptable. No results reported by the laboratory were qualified or rejected during the quality assurance review. Data quality was assessed by reviewing the laboratory case narrative and the results of the applicable analytical quality control measurements for each analysis completed. To determine whether an analyte detected in any sample was the result of possible contamination at the laboratory, the results for all method blanks were reviewed. No target analytes were detected in any method blank. Analytical accuracy was quantified as the recovery of matrix spike analyses for dissolved metals, sulfate, and cyanide. The control limits for the applicable matrix spike recoveries were met. Analytical precision was quantified as the relative percent difference (RPD) between laboratory duplicate sample analyses for all analytes. The control limits for the applicable RPDs were met.

Field Quality Control Samples

The field quality control samples included one field duplicate sample collected from station SVS-8 and analyzed for all target analytes (except cyanide), one field duplicate sample collected from station SVS-12 and analyzed for cyanide only, one bottle blank, and one filter blank. The RPDs between the original sample analyses and the duplicate field sample analyses for all analytes of concern were acceptable. TDS was detected in the bottle blank and hardness (as CaCO_3) was detected in the filter blank. No sample results required qualification based on the presence of the of these two analytes because these analytes were present in all natural samples at concentrations significantly greater than the concentrations found the field blanks.

If you have any questions or comments regarding the information presented in this letter or the data table, please feel free to contact me at (503) 636-4338. PTI appreciates the opportunity to support ESA Consultants, Inc. on this project.

Sincerely,



Laura Jones
Senior Chemist

Attachment

cc: Mr. Todd Sullivan/ESA

TABLE 1. RICO POST VOLUNTARY CLEANUP PROGRAM SURFACE WATER SAMPLE RESULTS - SUMMER QUARTER

Station	Date	Time	Field Rep.	Dissolved Metals (µg/L)						Hardness (mg/L)	Total Cyanide	Total Dissolved Solids	Total Suspended Solids	Sulfate (mg/L)	
				Cadmium	Copper	Iron	Lead	Manganese	Silver		Zinc	(mg/L)	(mg/L)		(mg/L)
DR-1-SW	7/30/97	15:50		0.2	10 U	98	0.5 U	66	0.1 U	65	67.2	122	140	20	
DR-2-SW	7/30/97	13:00		0.3	10 U	53	0.5 U	62	0.1 U	90	83.0	142	48	26	
DR-4-SW	7/30/97	15:15		0.1 U	10 U	62	0.5 U	48	0.1 U	36	79.0	125	159	25	
DR-6-SW	7/31/97	10:40		0.5	10 U	126	0.7	209	0.1 U	127	122	169	5 U	26	
DR-7-SW	7/31/97	11:30		1.5	10 U	3120	4.2	963	0.1 U	567	599	686	5 U	140	
DR-8-SW	7/30/97	10:30		3.5	21	36	0.5 U	357	0.1 U	1480	858	1080	5 U	280	
DR-10-SW	7/31/97	9:15		1.7	10 U	101	0.5 U	366	0.1 U	626	760	983	5 U	290	
DR-15a-SW	7/31/97	11:00		0.5	10 U	20 U	0.8	5 U	0.1 U	76	65.3	116	5 U	15	
DR-16-SW	7/30/97	8:20		15.9	10 U	52	0.5 U	1930	0.1 U	7690	1030	840	8	200	
DR-18-SW	7/30/97	14:30		0.1 U	10 U	68	0.5 U	52	0.1 U	41	74.0	121	168	23	
SVS-5	7/29/97	10:30		2.1	10 U	341	0.7	143	0.1 U	353	87.2	112	5 U	14	
SVS-8	7/29/97	12:22		1.8	10 U	101	0.6	235	0.1 U	347	112	178	5 U	36	
SVS-8	7/29/97	12:22	A	1.8	10 U	84	0.5 U	231	0.1 U	340	110	162	5 U	35	
SVS-11	7/29/97	13:55		1.9	10 U	2260	0.5 U	6690	0.1 U	3620	792	1170	5 U	690	
SVS-12	7/29/97	15:10		0.5	10 U	11900	5.9	7250	0.1 U	5890	710	0.01 U	1090	10	480
SVS-12	7/29/97	15:10	A									0.02			
Bottle Blank	7/30/97	14:30										18	5 U	0.2 U	
Filter Blank	7/30/97	14:30		0.1 U	10 U	20 U	0.5 U	5 U	0.1 U	10 U	0.3				

Qualifier: U - undetected at detection limit shown.

E3 Laboratory QA/QC Reports

E3.1 Fall 1996 Quarter

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
 Project: RICO/CA47-0601
 Sample Matrix: Water

Service Request: K9606826
 Date Collected: 10/23/96
 Date Received: 10/25/96
 Date Analyzed: 10/28/96

Cyanide, Total
 EPA Method 335.2
 Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

	True Value	Measured Value	Percent Recovery
Source: ERA Lot #9967	0.38	0.36	95

CALIBRATION VERIFICATION STANDARD

	True Value	Measured Value	Percent Recovery
CCV 1 Result	0.10	0.10	100
CCV 2 Result	0.10	0.10	100
CCV 3 Result	0.10	0.11	110
CCV 4 Result	0.10	0.11	110
CCV 5 Result	0.10	0.10	100

LABORATORY BLANK

	MRL	Blank Value
CCB 1 Result	0.01	ND
CCB 2 Result	0.01	ND
CCB 3 Result	0.01	ND
CCB 4 Result	0.01	ND
CCB 5 Result	0.01	ND

DUPLICATE ANALYSIS

Sample Name	Lab Code	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
00155	K9606826-021D	0.01	ND	ND	ND	-

MATRIX SPIKE ANALYSIS

Sample Name	Lab Code	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery
00155	K9606826-021MS	0.01	0.10	ND	0.09	90

Approved By: _____

Date: _____

11/12/96 00015

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
 Project: RICO/CA47-0601
 Sample Matrix: Water

Service Request: K9606826
 Date Collected: 10/24/96
 Date Received: 10/25/96
 Date Analyzed: 11/2,9,10/96

Sulfate
 EPA Method 300.0
 Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

	True Value	Measured Value	Percent Recovery
Source: CAS STD ID #AN/I-14-J	25	26	104
CAS STD ID #AN/I-14-J	25	26	104

CALIBRATION VERIFICATION STANDARD

	True Value	Measured Value	Percent Recovery
CCV 5 Result	5.0	5.1	102
CCV 6 Result	5.0	5.4	108
CCV 1 Result	5.0	5.2	104
CCV 2 Result	5.0	5.3	106
CCV 3 Result	5.0	5.3	106
CCV 4 Result	5.0	5.3	106

LABORATORY BLANK

	MRL	Blank Value
CCB 5 Result	0.2	ND
CCB 6 Result	0.2	ND
CCB 1 Result	0.2	ND
CCB 2 Result	0.2	ND
CCB 3 Result	0.2	ND
CCB 4 Result	0.2	ND

DUPLICATE ANALYSIS

Sample Name	Lab Code	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
00157	K9606826-002D	0.2	78	95	86	20

MATRIX SPIKE ANALYSIS

Sample Name	Lab Code	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery
00157	K9606826-002MS	0.2	40	78	125	102

Approved By: 

Date: 11/12/96

00016

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO/CA47-0601
Sample Matrix: Water

Service Request: K9606826
Date Collected: 10/24/96
Date Received: 10/25/96
Date Analyzed: 10/28-30/96

Solids, Total Dissolved (TDS)
EPA Method 160.1
Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

Lab Code:		True Value	Measured Value	Percent Recovery
Source:	APG 3664 Lot #35552	943	980	104
	APG 3664 Lot #35552	943	1010	107
	APG 3664 Lot #35552	943	1000	106

DUPLICATE ANALYSIS

Sample Name	Lab Code	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
00157	K9606826-002D	5	233	241	237	3
00142	K9606826-008D	5	910	898	904	2
00124	K9606826-023D	5	159	142	151	11

Approved By: 

Date: 11/12/96 00017

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO/CA47-0601
Sample Matrix: Water

Service Request: K9606826
Date Collected: 10/24/96
Date Received: 10/25/96
Date Analyzed: 10/28-30/96

Solids, Total Suspended (TSS)
EPA Method 160.2
Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

Lab Code:		True Value	Measured Value	Percent Recovery
Source:	APG 3664 Lot #35552	472	448	95
	APG 3664 Lot #35552	472	473	100
	APG 3664 Lot #35552	472	468	99

DUPLICATE ANALYSIS

Sample Name	Lab Code	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
00157	K9606826-002D	5	5	ND	-	-
00142	K9606826-008D	5	ND	ND	ND	-
00124	K9606826-023D	5	ND	ND	ND	-

Approved By: 

Date:

11/12/96 00018

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: Rico SW Monitoring/CA47-0601
Sample Matrix: Water

Service Request: K9606826
Date Collected: 10/22-24/96
Date Received: 10/25/96
Date Extracted: 11/4,6/96
Date Analyzed: 11/6/96

Duplicate Summary
Metals
Units: mg/L (ppm)

Sample Name: 00156
Lab Code: K9606826-001

Analyte	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Hardness, as CaCO ₃	0.2	171	169	170	1

Approved By: _____

Date: 11/28/96

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: Rico SW Monitoring/CA47-0601
Sample Matrix: Water

Service Request: K9606826
Date Collected: 10/22-24/96
Date Received: 10/25/96
Date Extracted: 11/4,6/96
Date Analyzed: 11/6/96

Duplicate Summary
Dissolved Metals
Units: µg/L (ppb)

Sample Name: 00156
Lab Code: K9606826-001

Analyte	EPA Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Cadmium	200.8	0.02	0.53	0.52	0.52	2
Copper	6010A	10	ND	ND	ND	-
Iron	6010A	20	112	108	110	4
Lead	200.8	0.02	0.12	0.11	0.12	8
Manganese	6010A	5	175	173	174	1
Mercury	7470	0.2	ND	ND	ND	-
Silver	200.8	0.02	ND	ND	ND	-
Zinc	6010A	10	124	121	122	2

Approved By: _____

Date: _____

DUP1SEPA/102194

06826ICP.GJ1 - DUP 11/8/96

00020

Page No.:

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: Rico SW Monitoring/CA47-0601
Sample Matrix: Water

Service Request: K9606826
Date Collected: 10/22-24/96
Date Received: 10/25/96
Date Extracted: 11/4,6/96
Date Analyzed: 11/6/96

Matrix Spike Summary
Dissolved Metals
Units: µg/L (ppb)

Sample Name: 00156
Lab Code: K9606826-001

Analyte	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS
						Percent Recovery Acceptance Limits
Cadmium	0.02	20	0.53	20.1	98	75-125
Copper	10	250	ND	248	99	75-125
Iron	20	1000	112	1090	98	75-125
Lead	0.02	20	0.12	20.8	103	75-125
Manganese	5	500	175	669	99	75-125
Mercury	0.2	1.0	ND	1.0	100	75-125
Silver	0.02	20	ND	18.4	92	75-125
Zinc	10	500	124	622	100	75-125

Approved By: _____

Date: _____

00021

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: Rico SW Monitoring/CA47-0601
LCS Matrix: Water

Service Request: K9606826
Date Collected: NA
Date Received: NA
Date Analyzed: 11/6/96

Laboratory Control Sample Summary
Dissolved Metals
Units: µg/L (ppb)

Source: CAS Spike Solution

Analyte	EPA Method	True Value	Result	Percent Recovery	CAS
					Percent Recovery Acceptance Limits
Cadmium	200.8	20.0	20.3	102	80-120
Calcium	6010A	12500	12800	102	80-120
Copper	6010A	625	626	100	80-120
Iron	6010A	2500	2520	101	80-120
Lead	200.8	20.0	20.0	100	80-120
Magnesium	6010A	12500	12500	100	80-120
Manganese	6010A	1250	1260	101	80-120
Mercury	7470	5.00	4.99	100	80-120
Silver	200.8	20.0	20.0	100	80-120
Zinc	6010A	1250	1290	103	80-120

Approved By: _____

Date: _____

LCSEPA/102194

068261CP.G/J1 - LCSW 11/11/96

00022

Page No.:

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: Rico SW Monitoring/CA47-0601

Service Request: K9606826
Date Analyzed: 11/6/96

Initial Calibration Verification (ICV) Summary
Metals
Units: µg/L (ppb)

ICV Source: Inorganic Ventures ICV

Analyte	EPA Method	True Value	Result	Percent Recovery
Cadmium	200.8	25.0	25.2	101
Calcium	6010A	12500	12700	102
Copper	6010A	625	628	100
Iron	6010A	2500	2560	102
Lead	200.8	50.0	49.8	100
Magnesium	6010A	12500	12600	101
Manganese	6010A	1250	1260	101
Mercury	7470	5.00	5.09	102
Silver	200.8	25.0	24.4	98
Zinc	6010A	1250	1210	97

Approved By: _____

Date: _____

11/11/96

00023

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: Rico SW Monitoring/CA47-0601

Service Request: K9606826
Date Analyzed: 11/6/96

Continuing Calibration Blank (CCB) Summary
Metals
Units: $\mu\text{g/L}$ (ppb)

Analyte	EPA Method	MRL	CCB1 Result	CCB2 Result	CCB3 Result	CCB4 Result
Cadmium	200.8	0.02	ND	ND	ND	-
Calcium	6010A	50	ND	ND	ND	ND
Copper	6010A	10	ND	ND	ND	ND
Iron	6010A	20	ND	ND	ND	ND
Lead	200.8	0.02	ND	ND	ND	-
Magnesium	6010A	10	ND	ND	ND	ND
Manganese	6010A	5	ND	ND	ND	ND
Mercury	7470	0.2	ND	ND	-	-
Silver	200.8	0.02	ND	ND	ND	-
Zinc	6010A	10	-80	ND	ND	ND

Approved By: _____

CCB4SMRL/102194

Date: _____

00024

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: Rico SW Monitoring/CA47-0601

Service Request: K9606826
Date Analyzed: 11/6/96

Continuing Calibration Blank (CCB) Summary

Metals

Units: µg/L (ppb)

Analyte	EPA Method	MRL	CCB5 Result	CCB6 Result	CCB7 Result
Cadmium	200.8	0.02	-	-	-
Calcium	6010A	50	ND	ND	ND
Copper	6010A	10	ND	ND	ND
Iron	6010A	20	ND	ND	ND
Lead	200.8	0.02	-	-	-
Magnesium	6010A	10	ND	ND	ND
Manganese	6010A	5	ND	ND	ND
Mercury	7470	0.2	-	-	-
Silver	200.8	0.02	-	-	-
Zinc	6010A	10	ND	ND	ND

Approved By: _____

Date: _____

CCB4SMRL/102194

00025

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: Rico SW Monitoring/CA47-0601

Service Request: K9606826
Date Analyzed: 11/6/96

Continuing Calibration Verification (CCV) Summary

Metals

Units: µg/L (ppb)

Analyte	EPA Method	True Value	CCV1 Result	Percent Recovery	CCV2 Result	Percent Recovery	CCV3 Result	Percent Recovery
Cadmium	200.8	25.0	25.0	100	24.7	99	24.0	96
Calcium	6010A	5000	4930	99	5070	101	5010	100
Copper	6010A	500	520	104	504	101	519	104
Iron	6010A	5000	5000	100	5050	101	4990	100
Lead	200.8	25.0	25.1	100	24.7	99	24.7	99
Magnesium	6010A	5000	4930	99	5060	101	4990	100
Manganese	6010A	500	487	97	505	101	503	101
Mercury	7470	5.00	5.08	102	5.09	102	-	-
Silver	200.8	25.0	25.0	100	24.4	98	23.5	94
Zinc	6010A	2500	2430	97	2530	101	2520	101

Approved By: _____

Date: _____

00026

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: Rico SW Monitoring/CA47-0601

Service Request: K9606826
Date Analyzed: 11/6/96

Continuing Calibration Verification (CCV) Summary

Metals

Units: $\mu\text{g/L}$ (ppb)

Analyte	EPA Method	True Value	CCV4 Result	Percent Recovery	CCV5 Result	Percent Recovery	CCV6 Result	Percent Recovery
Cadmium	200.8	25.0	-	-	-	-	-	-
Calcium	6010A	5000	5120	102	5030	101	5010	100
Copper	6010A	500	503	101	501	100	505	101
Iron	6010A	5000	5060	101	5020	100	5010	100
Lead	200.8	25.0	-	-	-	-	-	-
Magnesium	6010A	5000	5070	101	5020	100	5010	100
Manganese	6010A	500	506	101	502	100	500	100
Mercury	7470	5.00	-	-	-	-	-	-
Silver	200.8	25.0	-	-	-	-	-	-
Zinc	6010A	2500	2540	102	2520	101	2500	100

Approved By: _____

Date: _____

11/11/96

00027

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: Rico SW Monitoring/CA47-0601

Service Request: K9606826
Date Analyzed: 11/6/96

Continuing Calibration Verification (CCV) Summary
Metals
Units: $\mu\text{g/L}$ (ppb)

Analyte	EPA Method	True Value	CCV7 Result	Percent Recovery
Cadmium	200.8	25.0	-	-
Calcium	6010A	5000	5150	103
Copper	6010A	500	506	101
Iron	6010A	5000	5120	102
Lead	200.8	25.0	-	-
Magnesium	6010A	5000	5130	103
Manganese	6010A	500	514	103
Mercury	7470	5.00	-	-
Silver	200.8	25.0	-	-
Zinc	6010A	2500	2540	102

Approved By: _____

Date: _____

11/11/96

00028

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO/#CA47-0601
Sample Matrix: Water

Service Request: K9606826
Date Collected: 10/22/96
Date Received: 10/25/96
Date Extracted: NA
Date Analyzed: 11/5-6/96

Surrogate Recovery Summary
Halogenated Volatile Organic Compounds
EPA Methods 5030A/8010B

Sample Name	Lab Code	Percent Recovery Bromochloromethane
00132	K9606826-031	105
00133	K9606826-032	92
00134	K9606826-033	105
00138	K9606826-037	105
00139	K9606826-038	90
Lab Control Sample	K961105-LCS	93
Duplicate Lab Control Sample	K961106-DLCS	93
Method Blank	K961105-MB	101

CAS Acceptance Limits: 38-131

Approved By: _____



Date: _____

11/18/96

00029

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO/#CA47-0601
LCS Matrix: Water

Service Request: K9606826
Date Collected: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 11/5/96

Laboratory Control Sample Summary
Halogenated Volatile Organic Compounds
EPA Methods 5030A/8010B
Units: µg/L (ppb)

Analyte	True Value	Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
1,1-Dichloroethene	20	18	91	32-165
Trichloroethene	20	20	101	71-139
Tetrachloroethene	20	19	96	57-157

Approved By: 
LCS/102194

Date: 11/18/96

00030

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

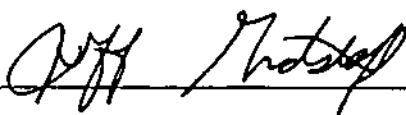
Client: PTI Environmental Services, Inc.
Project: RICO/#CA47-0601
LCS Matrix: Water

Service Request: K9606826
Date Collected: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 11/5-6/96

Laboratory Control Sample/Duplicate Laboratory Control Sample Summary
Halogenated Volatile Organic Compounds
EPA Methods 5030A/8010B
Units: µg/L (ppb)

Analyte	True Value		Result		Percent Recovery			Relative Percent Difference
	LCS	DLCS	LCS	DLCS	LCS	DLCS	CAS	
							Acceptance Limits	
1,1-Dichloroethene	20	20	18	18	91	88	32-165	4
Trichloroethene	20	20	20	20	101	102	71-139	2
Tetrachloroethene	20	20	19	18	96	92	57-157	4

Approved By: _____



Date: _____

11/18/96

00031

DLCS032395

E3.2 Winter 1997 Quarter

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-01-01
Sample Matrix: Water

Service Request: K9700452
Date Collected: 1/21/97
Date Received: 1/24/97
Date Extracted: NA

Duplicate Summary
Inorganic Parameters
Units: mg/L (ppm)

Sample Name: 00163
Lab Code: K9700452-002D

Analyte	EPA Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Solids, Total Dissolved (TDS)	160.1	5	662	678	670	2
Solids, Total Suspended (TSS)	160.2	5	10	10	10	< 1
Sulfate	300.0	0.2	330	330	330	< 1

Approved By: _____

Date: _____

DUP1SEPA/102194

K9700452.XLS - MixedDup 2/18/97

00012

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-01-01
Sample Matrix: Water

Service Request: K9700452
Date Collected: 1/21/97
Date Received: 1/24/97
Date Extracted: 2/6/97

Matrix Spike Summary
Inorganic Parameters
Units: mg/L (ppm)

Sample Name: 00163
Lab Code: K9700452-002MS

Analyte	EPA Method	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
Sulfate	300.0	0.2	200	330	530	100	75-125

Approved By: _____

Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-01-01
Sample Matrix: Water

Service Request: K9700452
Date Collected: 1/21-23/97
Date Received: 1/24/97
Date Extracted: 1/31-2/3/97
Date Analyzed: 2/3/97

Duplicate Summary
Dissolved Metals
Units: µg/L (ppb)

Sample Name: 00162
Lab Code: K9700452-001

Analyte	EPA Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Cadmium	200.8	0.02	0.58	0.57	0.58	2
Copper	6010A	10	ND	ND	ND	-
Iron	6010A	20	10200	10200	10200	<1
Lead	200.8	0.5	2.0	2.0	2.0	<1
Manganese	6010A	5	5250	5290	5270	<1
Silver	200.8	0.02	ND	ND	ND	-
Zinc	6010A	10	4710	4770	4740	1

Approved By: _____

Date: _____

DUP1SEPA/102194

00452ICP.GJ1 - DUP 2/6/97

Page No.:

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COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-01-01
Sample Matrix: Water

Service Request: K9700452
Date Collected: 1/21-23/97
Date Received: 1/24/97
Date Extracted: 1/31-2/3/97
Date Analyzed: 2/3/97

Matrix Spike Summary
Dissolved Metals
Units: µg/L (ppb)

Sample Name: 00162
Lab Code: K9700452-001

Analyte	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS
						Percent Recovery Acceptance Limits
Cadmium	0.02	20	0.58	19.9	97	75-125
Copper	10	250	ND	238	95	75-125
Iron	20	1000	10200	11000	NA	75-125
Lead	0.5	20	2.0	22.7	104	75-125
Manganese	5	500	5250	5680	NA	75-125
Silver	0.02	20	ND	18.0	90	75-125
Zinc	10	500	4710	5190	NA	75-125

NA Not Applicable; see case narrative.

Approved By: _____

Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-01-01
Sample Matrix: Water

Service Request: K9700452
Date Collected: 1/21-23/97
Date Received: 1/24/97
Date Extracted: 2/3/97
Date Analyzed: 2/3/97

Duplicate Summary
Metals
Units: mg/L (ppm)

Sample Name: 00162
Lab Code: K9700452-001

Analyte	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Hardness, as CaCO ₃	0.2	444	444	444	<1

Approved By: _____

Date: _____

E3.3 Spring 1997 Quarter

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP
Sample Matrix: Water

Service Request: K9702631
Date Collected: 4/16-18/97
Date Received: 4/21/97
Date Analyzed: 4/22,23/97

Solids, Total Dissolved (TDS)
EPA Method 160.1
Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

Lab Code:		True Value	Measured Value	Percent Recovery
Source:	APG 3664 Lot #39247	508	514	101
	APG 3664 Lot #39247	508	514	101

DUPLICATE ANALYSIS

Sample Name	Lab Code	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
00189	K9702631-002D	5	141	146	144	3
00203	K9702631-016D	5	478	486	482	2
00219	K9702631-032D	5	178	196	187	10

Approved By: _____

Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP
Sample Matrix: Water

Service Request: K9702631
Date Collected: 4/16-18/97
Date Received: 4/21/97
Date Analyzed: 4/22,23/97

Solids, Total Suspended (TSS)
EPA Method 160.2
Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

Lab Code:		True Value	Measured Value	Percent Recovery
Source:	APG 3664 Lot #39247	253	230	91
	APG 3664 Lot #39247	253	237	94

DUPLICATE ANALYSIS

Sample Name	Lab Code	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
00189	K9702631-002D	5	ND	ND	ND	-
00203	K9702631-016D	5	32	40	36	22
00219	K9702631-032D	5	ND	ND	ND	-

Approved By: _____

Date: _____

5/7/97

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
 Project: RICO POST-VCUP
 Sample Matrix: Water

Service Request: K9702631
 Date Collected: 4/16-18/97
 Date Received: 4/21/97
 Date Analyzed: 5/6/97

Sulfate
 EPA Method 300.0
 Units: mg/L (ppm)

LABORATORY CONTROL SAMPLE

	True Value	Measured Value	Percent Recovery
Source: CAS ID #ANI-14-BB	25	26	104

CALIBRATION VERIFICATION STANDARD

	True Value	Measured Value	Percent Recovery
CCV 1 Result	5.0	5.0	100
CCV 2 Result	5.0	5.1	102
CCV 3 Result	5.0	5.1	102
CCV 4 Result	5.0	5.1	102
CCV 5 Result	5.0	5.1	102

LABORATORY BLANK

	MRL	Blank Value
CCB 1 Result	0.2	ND
CCB 2 Result	0.2	ND
CCB 3 Result	0.2	ND
CCB 4 Result	0.2	ND
CCB 5 Result	0.2	ND

DUPLICATE ANALYSIS

Sample Name	Lab Code	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
00189	K9702631-002D	0.2	16	16	16	< 1

MATRIX SPIKE ANALYSIS

Sample Name	Lab Code	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery
00189	K9702631-002MS	0.2	10	16	27	110

Approved By: _____

Date: _____

5/19/97

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP
Sample Matrix: Water

Service Request: K9702631
Date Collected: 4/16-18/97
Date Received: 4/21/97
Date Extracted: 4/30/97
Date Analyzed: 5/1/97

Duplicate Summary
Dissolved Metals
Units: µg/L (ppb)

Sample Name: 00188
Lab Code: K9702631-001

Analyte	EPA Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Cadmium	200.8	0.02	2.32	2.37	2.34	2
Copper	6010A	10	ND	ND	ND	-
Iron	6010A	20	27	33	30	20
Lead	200.8	0.5	ND	ND	-	NC
Manganese	6010A	5	82	83	82	1
Silver	200.8	0.02	ND	ND	ND	-
Zinc	6010A	10	358	364	361	2

Approved By: _____

Date: _____

DUP1SEPA/102194

026311CP.G/1 - DUP rev 6-6-97 6/6/97

00016

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP
Sample Matrix: Water

Service Request: K9702631
Date Collected: 4/16-18/97
Date Received: 4/21/97
Date Extracted: 4/30/97
Date Analyzed: 5/1/97

Matrix Spike Summary
Dissolved Metals
Units: µg/L (ppb)

Sample Name: 00188
Lab Code: K9702631-001

Analyte	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS
						Percent Recovery Acceptance Limits
Cadmium	0.02	20	2.32	21.4	95	75-125
Copper	10	250	ND	247	99	75-125
Iron	20	1000	27	990	96	75-125
Lead	0.5	20	0.18	19.8	98	75-125
Manganese	5	500	82	554	94	75-125
Silver	0.02	20	ND	17.6	88	75-125
Zinc	10	500	358	849	98	75-125

Approved By: _____

Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP
LCS Matrix: Water

Service Request: K9702631
Date Collected: NA
Date Received: NA
Date Analyzed: 5/1/97

Laboratory Control Sample Summary
Dissolved Metals
Units: µg/L (ppb)

Source: CAS Spike Solution

Analyte	EPA Method	True Value	Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
					Limits
Cadmium	200.8	20.0	19.4	97	80-120
Copper	6010A	625	671	107	80-120
Iron	6010A	2500	2640	106	80-120
Lead	200.8	20.0	19.8	99	80-120
Manganese	6010A	1250	1310	105	80-120
Silver	200.8	20.0	18.3	92	80-120
Zinc	6010A	1250	1340	107	80-120

Approved By: _____

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Date: _____

Handwritten date: 5/5/97

QA/QC Report

Service Request: K9702631
Date Analyzed: 5/1/97

Metals

ICV Source: Inorganic Ventures ICV

Analyte	EPA Method	True Value	Result	Percent Recovery
Cadmium	200.8	25.0	24.5	98
Copper	6010A	625	645	103
Iron	6010A	2500	2550	102
Lead	200.8	50.0	49.6	99
Manganese	6010A	1250	1270	102
Silver	200.8	25.0	25.0	100
Zinc	6010A	1250	1310	105

Date:

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP

Service Request: K9702631
Date Analyzed: 5/1/97

Continuing Calibration Verification (CCV) Summary
Metals
Units: $\mu\text{g/L}$ (ppb)

Analyte	EPA Method	True Value	CCV1 Result	Percent Recovery	CCV2 Result	Percent Recovery	CCV3 Result	Percent Recovery
Cadmium	200.8	25.0	24.9	100	25.0	100	25.2	101
Copper	6010A	500	500	100	501	100	503	101
Iron	6010A	5000	5030	101	5020	100	5020	100
Lead	200.8	25.0	25.0	100	24.9	100	24.9	100
Manganese	6010A	500	494	99	490	98	489	98
Silver	200.8	25.0	25.4	102	24.7	99	23.8	95
Zinc	6010A	2500	2500	100	2520	101	2530	101

Approved By: _____

Date: _____

QA/QC Report

Service Request: K9702631
Date Analyzed: 5/1/97

Continuing Calibration Verification (CCV) Summary
Metals
Units: µg/L (ppb)

Analyte	EPA Method	True Value	CCV4 Result	Percent Recovery	CCV5 Result	Percent Recovery
Cadmium	200.8	25.0	25.4	102	-	-
Copper	6010A	500	504	101	502	100
Iron	6010A	5000	5010	100	5130	103
Lead	200.8	25.0	24.9	100	-	-
Manganese	6010A	500	484	97	486	97
Silver	200.8	25.0	24.0	96	-	-
Zinc	6010A	2500	2520	101	2510	100

CCV 4-6/042795
026311CP.GJ1 - CCV 4-6 5/1/93

00021

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP

Service Request: K9702631
Date Analyzed: 5/1/97

Continuing Calibration Blank (CCB) Summary
Metals
Units: $\mu\text{g/L}$ (ppb)

Analyte	EPA Method	MRL	CCB1 Result	CCB2 Result	CCB3 Result	CCB4 Result
Cadmium	200.8	0.02	ND	ND	ND	ND
Copper	6010A	10	ND	ND	ND	ND
Iron	6010A	20	ND	ND	ND	ND
Lead	200.8	0.5	ND	ND	ND	ND
Manganese	6010A	5	ND	ND	ND	ND
Silver	200.8	0.02	ND	ND	ND	ND
Zinc	6010A	10	ND	ND	ND	ND

Approved By: _____

Date: _____

CCB4SMRL/102194

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP

Service Request: K9702631
Date Analyzed: 5/1/97

Continuing Calibration Blank (CCB) Summary

Metals

Units: $\mu\text{g/L}$ (ppb)

Analyte	EPA Method	MRL	CCBS Result
Cadmium	200.8	0.02	-
Copper	6010A	10	ND
Iron	6010A	20	ND
Lead	200.8	0.5	-
Manganese	6010A	5	ND
Silver	200.8	0.02	-
Zinc	6010A	10	ND

Approved By: _____

CCB4SMRL/102194

Date: 6/6/97

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP
Sample Matrix: Water

Service Request: K9702631
Date Collected: 4/16-18/97
Date Received: 4/21/97
Date Extracted: 4/30/97
Date Analyzed: 5/1/97

Duplicate Summary
Metals
Units: mg/L (ppm)

Sample Name: 00188
Lab Code: K9702631-001

Analyte	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Hardness, as CaCO ₃	0.2	108	109	108	<1

Approved By: _____

Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP
LCS Matrix: Water

Service Request: K9702631
Date Collected: NA
Date Received: NA
Date Analyzed: 5/1/97

Laboratory Control Sample Summary
Total Metals
Units: µg/L (ppb)

Source: Inorganic Ventures

Analyte	EPA Method	True Value	Result	Percent Recovery	CAS
					Percent Recovery Acceptance Limits
Calcium	6010A	12500	13400	107	80-120
Magnesium	6010A	12500	13100	105	80-120

Approved By: _____

Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP

Service Request: K9702631
Date Analyzed: 5/1/97

Initial Calibration Verification (ICV) Summary

Metals

Units: $\mu\text{g/L}$ (ppb)

ICV Source: Inorganic Ventures ICV

Analyte	EPA Method	True Value	Result	Percent Recovery
Calcium	6010A	12500	12900	103
Magnesium	6010A	12500	12700	102

Approved By: _____

Date: _____

ICVEPA/102194

02631ICP.EA1 - ICV 5/2/97

Page No.:

00026

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP

Service Request: K9702631
Date Analyzed: 5/1/97

Continuing Calibration Verification (CCV) Summary
Metals
Units: µg/L (ppb)

Analyte	EPA Method	True Value	CCV1 Result	Percent Recovery	CCV2 Result	Percent Recovery	CCV3 Result	Percent Recovery
Calcium	6010A	5000	5000	100	5000	100	5100	102
Magnesium	6010A	5000	5000	100	4970	99	4990	100

Approved By: _____

Date: 5/5/97

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP

Service Request: K9702631
Date Analyzed: 5/1/97

Continuing Calibration Verification (CCV) Summary
Metals
Units: $\mu\text{g/L}$ (ppb)

Analyte	EPA Method	True Value	CCV4 Result	Percent Recovery	CCV5 Result	Percent Recovery
Calcium	6010A	5000	5040	101	5250	105
Magnesium	6010A	5000	4950	99	5220	104

Approved By: _____

Date: _____

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP

Service Request: K9702631
Date Analyzed: 5/1/97

Continuing Calibration Blank (CCB) Summary

Metals

Units: $\mu\text{g/L}$ (ppb)

Analyte	EPA Method	MRL	CCB1 Result	CCB2 Result	CCB3 Result	CCB4 Result
Calcium	6010A	50	ND	ND	ND	ND
Magnesium	6010A	10	ND	ND	ND	ND

Approved By: _____

Date: _____

CCB4SMRL/102194

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP

Service Request: K9702631
Date Analyzed: 5/1/97

Continuing Calibration Blank (CCB) Summary

Metals

Units: $\mu\text{g/L}$ (ppb)

Analyte	EPA Method	MRL	CCB5 Result
Calcium	6010A	50	ND
Magnesium	6010A	10	ND

Approved By: _____

Date: _____

CCB4SMRL/102194

E3.4 Summer 1997 Quarter

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-0101
Sample Matrix: Water

Service Request: K9705429
Date Collected: 7/30/97
Date Received: 8/1/97
Date Extracted: NA

Duplicate Summary
Inorganic Parameters
Units: mg/L (ppm)

Sample Name: 00234
Lab Code: K9705429-001DUP

Analyte	EPA Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Solids, Total Dissolved (TDS)	160.1	5	840	851	846	1
Solids, Total Suspended (TSS)	160.2	5	8	7	8	12
Sulfate	300.0	0.2	200	200	200	<1

Approved By: aspDate: 8/18/97

DUP1SEPA/102194

05429WET.LJ2 - dup (2) 8/18/97

00013

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-0101
Sample Matrix: Water

Service Request: K9705429
Date Collected: 7/30/97
Date Received: 8/1/97
Date Extracted: NA

Matrix Spike Summary
Inorganic Parameters
Units: mg/L (ppm)

Sample Name: 00234
Lab Code: K9705429-001MS

Analyte	EPA Method	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
Sulfate	300.0	0.2	100	200	320	120	80-120

Approved By: asp **Date:** 8/18/97

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-0101
Sample Matrix: Water

Service Request: K9705429
Date Collected: 7/29/97
Date Received: 8/1/97
Date Extracted: NA
Date Analyzed: 8/12/97

Duplicate Summary
 Cyanide, Total
 EPA Method 335.2
 Units: mg/L (ppm)

Sample Name	Lab Code	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
00231	K9705429-026D	0.01	ND	0.01	NA	-

Approved By: asp Date: 8/18/97

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-0101
Sample Matrix: Water

Service Request: K9705429
Date Collected: 7/29/97
Date Received: 8/1/97
Date Extracted: NA
Date Analyzed: 8/12/97

Matrix Spike Summary
Cyanide, Total
EPA Method 335.2
Units: mg/L (ppm)

Sample Name	Lab Code	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS Percent Recovery Acceptance Limits
00231	K9705429-026MS	0.01	0.10	ND	0.10	100	75-125

Approved By: aspDate: 8/18/97

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Service, Inc.
Project: RICO POST-VCUP/CB41-0101
Sample Matrix:

Service Request: K9705429
Date Collected: 7/29-31/97
Date Received: 8/1/97
Date Extracted: 8/7/97
Date Analyzed: 8/13/97

Duplicate Summary
Metals
Units: mg/L (ppm)

Sample Name: 00235
Lab Code: K9705429-002

Analyte	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Hardness, as CaCO ₃	0.2	858	876	867	2

Approved By: _____

Date: _____

8/15/97

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-0101
Sample Matrix: Water

Service Request: K9705249
Date Collected: 7/29-31/97
Date Received: 8/1/97
Date Extracted: 8/7/97
Date Analyzed: 8/13/97

Duplicate Summary
Dissolved Metals
Units: µg/L (ppb)

Sample Name: 00235
Lab Code: K9705429-002

Analyte	EPA Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
Cadmium	200.8	0.1	3.5	3.4	3.4	3
Copper	6010A	10	21	21	21	<1
Iron	6010A	20	36	34	35	6
Lead	200.8	0.5	ND	ND	ND	-
Manganese	6010A	5	357	364	360	2
Silver	200.8	0.1	ND	ND	ND	-
Zinc	6010A	10	1480	1510	1500	2

Approved By: _____

Date: _____

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COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: PTI Environmental Services, Inc.
Project: RICO POST-VCUP/CB41-0101
Sample Matrix: Water

Service Request: K9705249
Date Collected: 7/29-31/97
Date Received: 8/1/97
Date Extracted: 8/7/97
Date Analyzed: 8/13/97

Matrix Spike Summary
Dissolved Metals
Units: µg/L (ppb)

Sample Name: 00235
Lab Code: K9705429-002

Analyte	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS
						Percent Recovery Acceptance Limits
Cadmium	0.1	100	3.5	103	100	75-125
Copper	10	250	21	255	94	75-125
Iron	20	1000	36	978	94	75-125
Lead	0.5	100	ND	97.2	97	75-125
Manganese	5	500	357	826	94	75-125
Silver	0.1	100	ND	93.2	93	75-125
Zinc	10	500	1480	1970	98	75-125

Approved By: _____

Date: _____